I-5/SR 161/SR 18 Interchange Improvements – Stage 2

Value Engineering/Practical Design Workshop

Final – Report

Prepared for

Washington State Department of Transportation

Lead Author

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Prepared By:

HDR, Inc.

Date

December 2014

Disclaimer:

The information contained in this report is the professional opinions of the team members during the Value Engineering/Practical Design Workshop. These opinions were based on the information provided to the team at the time of the workshop. As the project continues to develop, new information will become available, and this information will need to be evaluated on how it may affect the recommendations and findings in this report. All costs displayed in the report are based on best available information at the time of the workshop and unless otherwise noted are in 2014 dollars.

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Table of Contents

Value Engineering/Practical Design Summary 1
Introduction 1
Practical Design through Value Engineering 1
VE/PD Recommendations 1
Introduction 3
Project Background 3
Practical Design 4
Performance Based Value Engineering 5
Scope of the VE/PD Workshop 6
VE/PD Workshop Timing 6
VE/PD Team Members 6
Project Description 7
Purpose and Need Statement: 7
Project Description 8
Constraints and Controlling Decisions 8
Investigation Observations 8
Project Schedule 10
Project Cost Estimate 11
Information Provided to the VE/PD Team 12
Project Analysis 13
Summary of Analysis 13
Cost Model 13
Performance Attributes 14
Performance Attribute Matrix 16
Functional Analysis 16
FAST Diagram 17
Creative Phase 19
Evaluation Phase 21
Development Phase 39
Performance Assessment 39
Design Considerations 41
FHWA Functional Benefit Criteria 42
Value Engineering Recommendation Approval 42
Recommendations 42

Appendix 71
VE Study Recommendation Approval Form.....73
VE/PD Workshop Agenda 75
VE/PD Workshop Attendees.....77
Value Engineering/Practical Design Report Out 79
Value Engineering Process 89

Value Engineering/Practical Design Summary

Introduction

This Value Engineering/Practical Design (VE/PD) report summarizes the events of the workshop conducted for the Washington State Department of Transportation (WSDOT) and facilitated by HDR Inc.

The subject of the VE/PD Workshop was I-5/SR 161/SR 18 Interchange Improvements – Stage 2 project. The workshop was conducted December 2-4, 2014 with the presentation of findings held December 8, 2014.

VE/PD Summary

Project Cost: $60.0 M

Number of Recommendations: 7

Recommended Cost Savings: $15.8 - $18.3M

Total Number of Team Members: 7

WSDOT Employees: 4

Others: 3

Facilitator: HDR Inc.

Cost of the Study: $12K (HDR)

Practical Design through Value Engineering

Practical Design is an approach to making project decisions that focus on the need for the project and looks for cost-effective solutions. A fully implemented practical design approach applies to all aspects of transportation system development, from system planning through all phases of project development.

One method to achieve Practical Design is through Value Engineering (VE). VE is a systematic process used by a multidisciplinary team to improve the value of a project through the analysis of its functions. By using the time proven process of value engineering combined with the practical design approach to project design, the most efficient solutions for the state's transportation needs can be realized.

The primary objectives of the team through application of the Value Engineering Job Plan (see the Appendix) were to:

- Conduct a thorough review and analysis of the key project issues using a multidiscipline, cross-functional team
- Improve the value of the project through innovative measures, such as Practical Design, aimed at improving the performance while reducing costs of the project
- Use a "fresh set of eyes" to search for new/innovative approaches to interchange design
- Develop tailored solutions that meet the project's purpose and need

VE/PD Recommendations

The VE/PD Team generated 48 ideas for the project. These ideas were compared against the baseline concept developed by the project team. The ideas that performed the best were further developed by the VE/PD Team. This resulted in 7 VE/PD Recommendations being brought forward and 21 ideas to be further considered by the design team.

The recommendations developed by the VE/PD Team are shown in Table 1 and are detailed in the Development Phase section of this report.

Table 1 - Summary of Recommendations (millions $)				
#	**Description**	**Construction Savings (Added)**	**Right-of-Way Savings**	**Performance**
1	Reduce Widths	$3.10		7%
2	Nested Guardrail	$0.06		5%
3	Signal Operations	N/A		21%
4	Southbound I-5 to Eastbound SR 18	$6.76		18%
5	Roundabout @ 356th	($1.26)	$3.07	40%
6	Access Control		$4.08	2%
7	Ramp Terminal	($1.60)	$8.16	42%
	Total	**$8.66**	**$7.15 - $11.23**	

The actual savings will depend on the recommendations accepted and their relationship to the other recommendations.

To facilitate implementation, a Value Engineering Recommendation Approval Form is included the Appendix. If the state elects to reject or modify a recommendation, please include a brief explanation of why.

The VE/PD Team wishes to express its appreciation to the project design team and management for the excellent support they provided during the workshop. Hopefully, the recommendations and other design considerations provided will assist in the management decisions necessary to move the project forward.

Blane H. Long, CVS®, CCT
VE/PD Team Leader

Introduction

This report summarizes the events of the VE/PD Workshop conducted for the Washington State Department of Transportation (WSDOT), facilitated by HDR Inc. The subject of the workshop was the I-5/SR 161/SR 18 Interchange Improvements – Stage 2 project.

Project Background

When the Interstate 5/State Route 18 interchange in Federal Way opened to traffic in the early 1960s its cloverleaf design was state of the art in freeway design. But that era's light traffic volumes concealed the major flaw of the cloverleaf interchange – the weaving that occurs when traffic merges on and off the freeway. Weaving increases congestion and the potential for collisions.

Figure 1 - I-5/SR 18 Interchange – October 2006

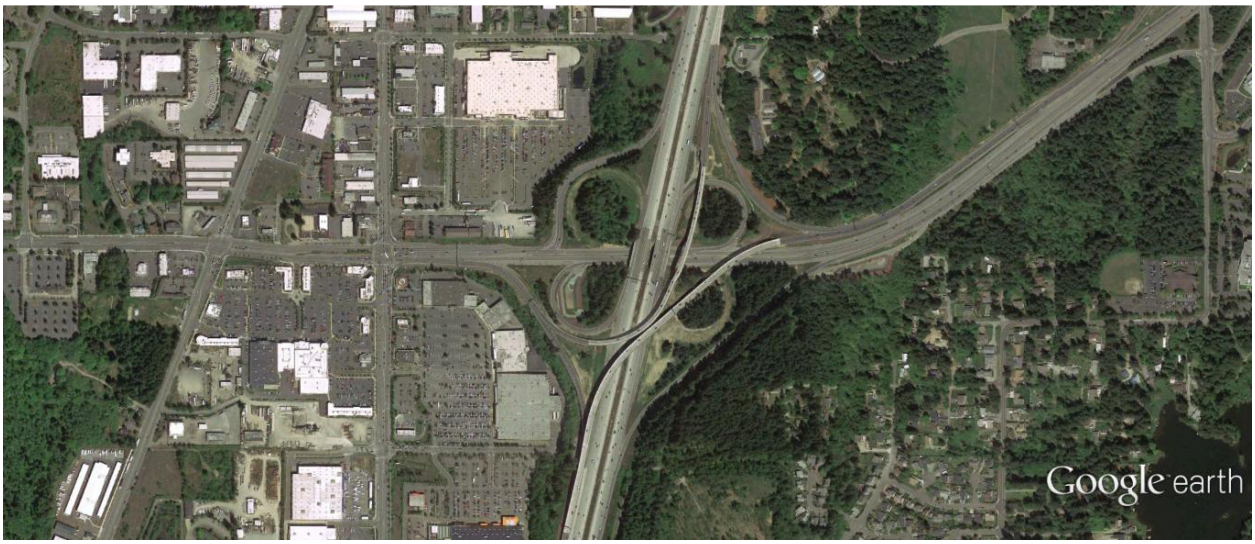

Figure 2 - I-5/SR 18 Interchange – May 2013

The problem wasn't obvious in the 1960's because I-5 and SR 18 each moved less than a quarter of the traffic they do now. Since the 60's King and Pierce counties have grown significantly, pushing the interchange beyond its limits. The existing loop ramps are substandard and two of the loop ramps are high-accident locations. As shown on Figure 4 these improvements are the second of three stages that will improve traffic flow and safety at this increasingly congested interchange.

Practical Design

Practical Design is an approach to making project decisions that focus on the need for the project and looks for cost-effective solutions. A fully implemented practical design approach applies to all aspects of transportation system development, from system planning through all phases of project development.

Focus on specific project needs:
With practical design, decision-making focuses on maximum benefit to the system, rather than maximum benefit to the project. Focusing on the specific project need minimizes the scope of work for each project. The goal is to allow more needs to be addressed system wide by reducing spending on lesser priority items on each project.

Changing with the times:
Technology and society are evolving and changing the needs and demands on the transportation system. Practical design encourages efficient, effective, and sustainable transportation decisions that can achieve:

- Maximum results with limited funding
- Tailored solutions for the project's purpose and need
- Phased solutions that address more critical and current needs
- Design guidance that transitions from a rigid structure to a more flexible framework
- Freedom to innovate

Practical design is an important component in implementing WSDOT's strategic plan:

- Innovation and solutions are encouraged
- No compromises to safety
- Community engagement is important to making decisions
- Collaboration ensures a wide array of perspectives

Why is WSDOT implementing practical design?

- Focuses the emphasis on the need for the project
- Moves from a standards-based to performance-based design approach
- Empower engineers to be innovative

Performance Based Value Engineering

Value Engineering (VE) has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of overlooking the role that value engineering can play to improve project performance. To address this issue, a performance-based VE approach was used.

The primary objective of any VE study is to improve the value of the project. A simple way to think of value in terms of an equation is shown to the right.

$$Value = \frac{Performance}{Cost}$$

While project costs are fairly easy to quantify and compare through traditional estimating techniques, performance is not so easily quantifiable.

The use of performance measures provides the cornerstone of the performance-based VE process by giving a systematic and structured way of considering the relationship of a project's performance and cost as it relates to value. Project performance must be properly defined and agreed on by the stakeholders at the beginning of the VE study. The performance attributes and requirements that are developed are then used throughout the study to identify, evaluate, and document alternatives.

The application of performance-based VE consists of the following steps:

1) Identify key project (scope and delivery) performance attributes and requirements for the project.
2) Establish the hierarchy and impact of these attributes on the project.
3) Establish the baseline of the current project performance by evaluating and rating the effectiveness of the current design concepts.
4) Identify the change in performance of alternative project concepts generated by the study.
5) Measure the aggregate effect of alternative concepts relative to the baseline project's performance as a measure of overall value improvement.

The following are the key project performance attributes that were used in this VE/PD Workshop:

- Mainline Operations
- Local Operations
- Maintainability
- Construction Impacts
- Environmental Impacts

A detailed definition of the performance attributes can be found in the Project Analysis section of this report.

Scope of the VE/PD Workshop

The scope of the VE/PD Workshop was to verify or improve upon the concepts being proposed for the I-5/SR 161/SR 18 Interchange Improvements – Stage 2 project. To accomplish this, the VE/PD Team:

- applied the principles and practices of the VE Job Plan (see the Appendix)
- conducted a thorough review and analysis of the key project issues using a multidiscipline, cross-functional team
- improved the value of the project through innovative measures, such as Practical Design, aimed at improving the performance while reducing costs of the project
- used a "fresh set of eyes" to search for new/innovative approaches to interchange design
- developed tailored solutions that meet the project's purpose and need

VE/PD Workshop Timing

The workshop was conducted December 2-4, 2014, with the VE/PD Report out being conducted on December 8, 2014. The project was at 15% design at the time of the workshop.

VE/PD Team Members

The list of participants in the VE/PD Workshop held from December 2-4, 2014 in Shoreline, WA is provided below. Other VE/PD Workshop attendees are identified on a sign-in sheet which is provided in the Appendix.

The VE/PD Team members included:

Blane Long	HDR	VE/PD Team Leader
Aleta Borschowa	WSDOT NWR	Construction
Brian Walsh	WSDOT HQ	Traffic/Roundabouts
Mazen Wallaia	WSDOT NWR	Design
Rick Perez	City of Federal Way	Traffic Engineer
Roy Siegel	FHWA	Design
Samih Shilbayeh	WSDOT HQ	VE/CRA Coordinator

Resources:

Jim Larson	WSDOT NWR	Design
Thomas LaBolle	WSDOT NWR	Design
Rob Brown	WSDOT NWR	Traffic

Project Description

Purpose and Need Statement:

- The I-5/SR 161/SR 18 "triangle" interchange experiences severe traffic congestion. This project is the second stage of a multi-stage project to improve mobility and safety in the interchange vicinity.

Stage 1 was completed in 2012 and constructed:

- a two-lane flyover ramp connecting westbound SR 18 to southbound I-5 and rebuilt the westbound SR 18 to northbound I-5 ramp to accommodate the new flyover ramp
- a new exit ramp connecting the new flyover ramp to SR 161 at S. 359th Street
- a new eastbound SR 18 to northbound I-5 flyover ramp and rebuilt the eastbound SR 18 to southbound I-5 ramp to accommodate the new eastbound to northbound flyover ramp

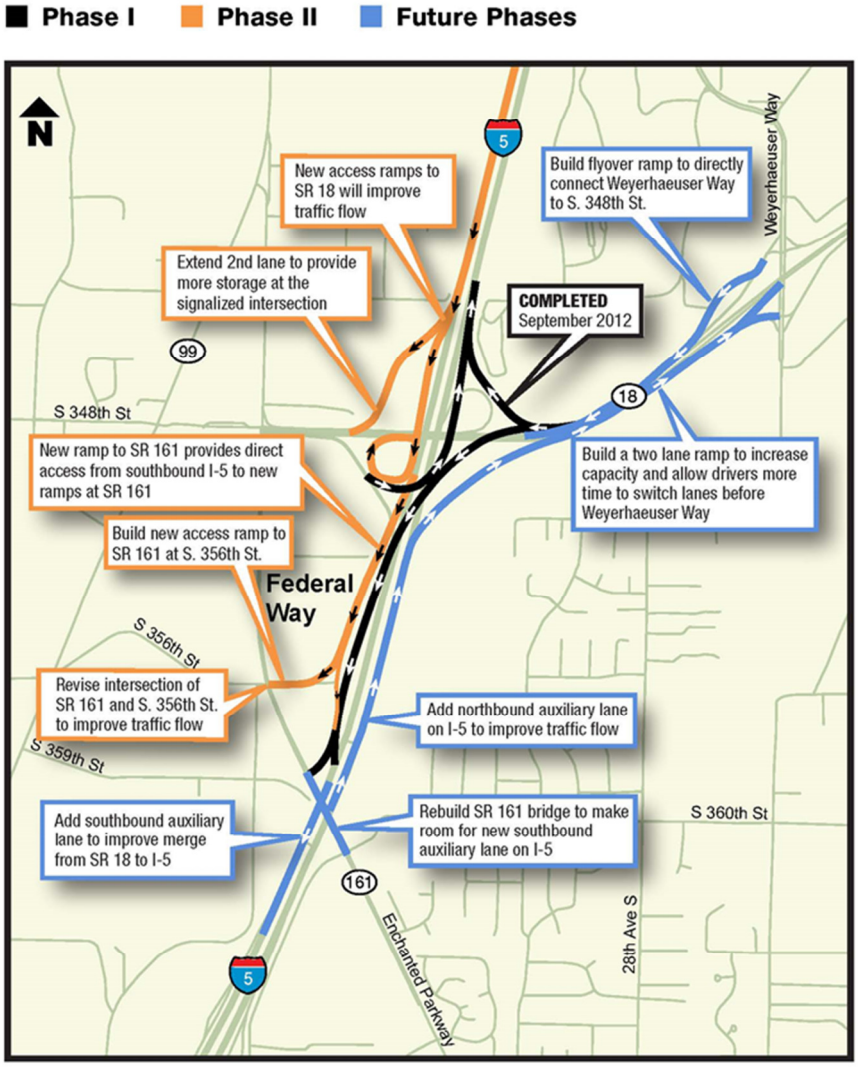

Figure 4 – Project Map

Project Description

This project is the second phase of a plan to improve mobility and reduce the risk of collisions at the I-5/SR 161/SR 18 interchange.

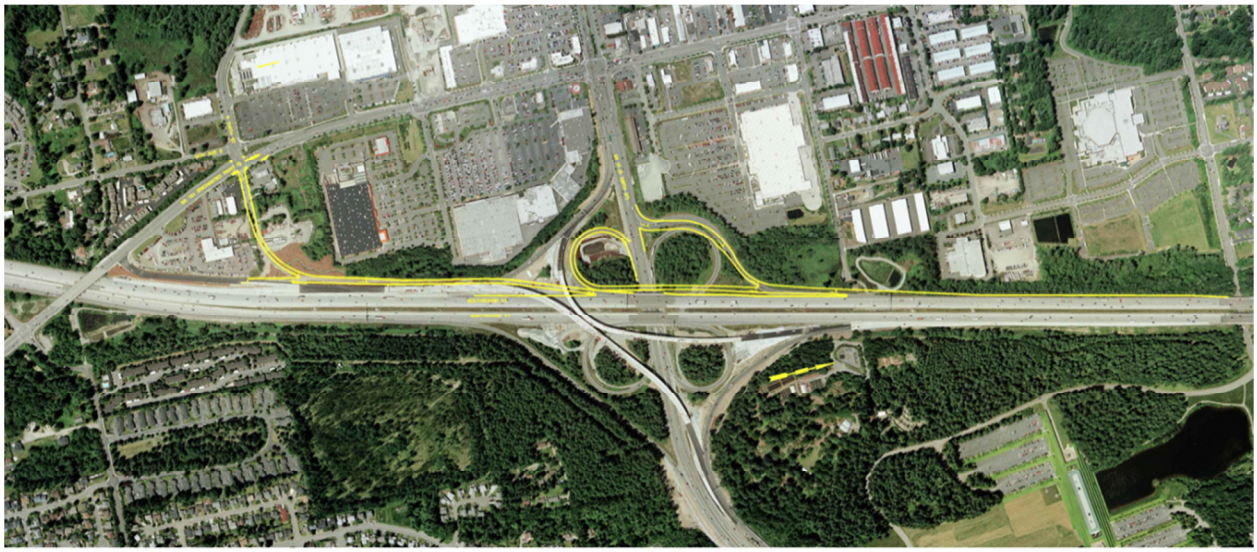

Figure 5 – Proposed Stage 2 Improvements

Construction will include two new bridges, retaining walls, reinforced slopes, guardrail, drainage, and signal and illumination work. These activities will take place primarily within State right of way along I-5.

Work includes constructing a new southbound I-5 off-ramp to SR 161, constructing an exit to the SR 161/S 356th St. Intersection, and alignment separation for southbound I-5 off-ramps to SR 18 and realigning the SR 18 off-ramps.

Constraints and Controlling Decisions

As part of the project briefing, the VE/PD Team was given the following project constraints and controlling factors for considering possible alternatives:

- The project is not currently funded for construction
- The project is scheduled to be put on the “shelf” in November 2015 at completion of the 30% design
- The project delivery method is currently considered to be design-build

Investigation Observations

The first day of the workshop included a presentation from the project team. The following summarizes key project issues, project drivers and observations identified during these sessions.

- Additional sensitive area impacts incurred due to project staging
- Additional foundation costs added due to construction experience from Stage 1

There are currently 3 options for the SR 161/356th Street Improvements:

Option A (Baseline for the VE/PD Workshop)

Figure 6 – Realignment of 16th Ave S.

- Realign 16th Avenue approximately 300' to the west in line with the commercial driveway and construct a new signal
- Close the existing 16th Avenue connection with 356th Street along with the slip ramp and signal at that location
- Add a right turn lane to southbound SR 161 from 356th Street

Option B

Figure 7 – New Access to 16th Ave S.

- Provide new access from SR 161 at 359th Street Off-ramp to 16th Avenue
- Close the existing 16th Avenue connection with 356th Street along with the slip ramp and signal at that location
- Add a right turn lane to southbound SR 161 from 356th Street

Option C

Figure 8 – Roundabout

- Construct a five-leg roundabout in place of the existing intersection
- Remove signals

Project Schedule

The project is scheduled to be put on the “shelf” in November 2015 at completion of the 30% design. There is currently no funding for construction.

Project Cost Estimate

The Project Manager provided the VE/PD Team with the scoping level estimate to use during the workshop. The following tables represent the major cost categories for each sub-project.

Table 2 – Cost Estimate

Project Element	Cost	Percent	Cumulative Percent
Ramp Bridge	$8,036,340	35.5%	35.5%
Bridge over SR 18	$2,890,000	12.8%	48.2%
Pavement/Surfacing	$2,070,016	9.1%	57.4%
Retaining Walls	$1,643,255	7.3%	64.6%
Erosion Control	$1,593,540	7.0%	71.7%
Permanent Traffic Control Items	$1,338,450	5.9%	77.6%
Stormwater	$1,285,271	5.7%	83.2%
Sensitive Areas	$1,140,000	5.0%	88.3%
WZTC	$1,076,003	4.7%	93.0%
Earthwork	$874,300	3.9%	96.9%
Hazardous Materials	$200,000	0.9%	97.8%
Surveying	$145,000	0.6%	98.4%
Other items	$145,000	0.6%	99.0%
Removals	$129,400	0.6%	99.6%
Sidewalk	$88,540	0.4%	100.0%
Subtotal	**$22,655,114**	**100.0%**	
Miscellaneous Items @ 25%	$5,663,779		
Project Subtotal	**$28,318,893**		
Mobilization (10%)	$2,831,889		
Project Subtotal	**$31,150,782**		
Sales Tax (9.5%)	$2,690,295		
Project Subtotal	**$33,841,077**		
Construction Engineering (10%)	$3,384,108		
Construction Contingencies (4%)	$1,353,643		
Engineering Design (20%)	$6,768,215		
Right-of-Way	$14,642,500		
Project Total	**$59,989,543**	**Effective Markup**	**100.2%**

Information Provided to the VE/PD Team

The following project documents were provided to the VE/PD Team for their use during the workshop:

Table 3 – Information Provided to VE/PD Team	
Document	**Date**
Channelization Plans	March 2014
Scoping Level Cost Estimate	March 2014
SR 161 & 356th Alternatives Handout	November 2014
VE Study Report – I-5/SR 18/SR 161 Interchange Improvements	September 2006
Project Design Schedule	November 2014
Profile Sheets	November 2014

Project Analysis

Summary of Analysis

The following analysis tools were used to study the project:

- Cost Model
- Performance Attributes
- Performance Attribute Matrix
- Functional Analysis
- FAST Diagram

Cost Model

The VE/PD Team Leader prepared a cost model from the cost estimate provided by the Project Manager. The cost model is organized to identify major construction elements or trade categories, and the percent of total project cost for the significant cost items.

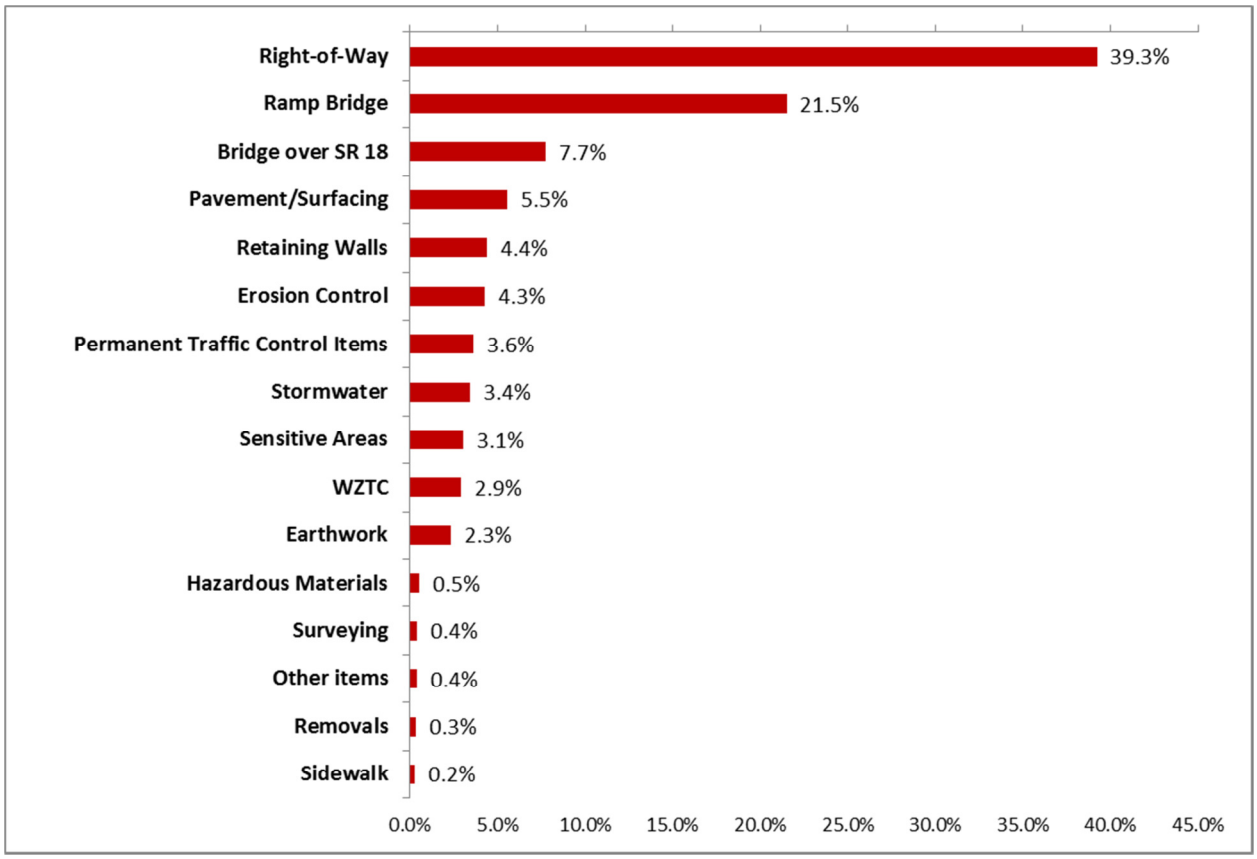

Figure 9 –Cost Model

While the structures (bridges and retaining walls) are the major construction items of this project the acquisition of right-of-way and relocating businesses are the highest cost items of the project.

Performance Attributes

Performance attributes are an integral part of the value engineering process. The performance of each project must be properly defined and agreed upon by the Project Team, VE/PD Team and stakeholders at the beginning of each workshop. The attributes represent those aspects of a project's scope and schedule that possess a range of potential values.

Performance attributes can generally be divided between project scope components (mainline operations, environmental impacts, maintainability, etc.) and project delivery components. It is important to make a distinction between performance attributes and performance requirements. Performance requirements are mandatory and binary in nature. All performance requirements MUST be met by any VE recommendation being considered.

Performance attributes possess a range of acceptable levels of performance. For example, if the project was the design and construction of a new bridge, a performance requirement might be that the bridge must meet all current seismic design criteria. In contrast, a performance attribute might be project schedule, which means a wide range of alternatives with different durations could be acceptable.

The VE/PD Team, along with the Project Team, identified and defined the performance attributes for this project and then defined the baseline concept as it pertains to these attributes. The following performance attributes were used throughout the workshop to identify, evaluate, and document ideas and recommendations.

Table 4 - Performance Attributes

Performance Attribute	Definition	Baseline
Mainline Operations	An assessment of traffic operations and safety on Interstate 5 (I-5) within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.	▪ Design Speed 70 MPH ▪ 12' auxiliary lanes ▪ 15' single lane ramps ▪ 12.5' dual lane ramps ▪ 10' shoulders on I-5 ▪ 4' inside and 8' outside shoulders on ramps
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure including SR 18 and SR 161. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane and shoulder widths; bicycle and pedestrian operations and access.	▪ Design Speed 25 MPH (16th) ▪ Design Speed 40 MPH (SR 161 & SR 18) ▪ 12' general purpose and turn lanes ▪ 5' outside shoulders (bikes) ▪ 8' sidewalks on 16th

Table 4 - Performance Attributes		
Performance Attribute	**Definition**	**Baseline**
Maintainability	An assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the overall durability, longevity and maintainability of pavements, structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.	▪ PCCP for the auxiliary lane on I-5 ▪ HMA for shoulders and ramp and city street lanes ▪ Both bridges are pre-stressed concrete girders
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust and construction traffic; environmental impacts.	▪ No impacts to SR 161 until new alignment of 16th is opened ▪ Weekend noise restrictions ▪ Possible permit restrictions to construct the ramp bridge ▪ General traffic control/staging while constructing ramps
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice, business, residents); impacts to cultural, recreational and historic resources.	▪ 5 businesses/properties are being acquired ▪ Approximately 3 acres of stream impacts ▪ Approximately 1 acre of wetland impacts

Performance Attribute Matrix

A matrix was used to determine the relative importance of the individual performance attributes for the project. The Project and VE/PD Teams evaluated the relative importance of the performance attributes that would be used to evaluate the creative ideas.

These attributes were compared in pairs, asking the question: "Which one is more important to the purpose and need of the project?" The letter code (e.g., "A") was entered into the matrix for each pair. After all pairs were discussed they were tallied (after normalizing the scores by adding a point to each attribute) and the percentages calculated.

Table 5 - Performance Attribute Matrix

Which attribute is more important to the purpose and need of the project?						TOTAL	%
Mainline Operations	**A**	A/B	A/C	A	A	4.0	26.7%
Local Operations		**B**	B	B	B	4.5	30.0%
Maintainability			**C**	C	E	2.5	16.7%
Construction Impacts				**D**	E	1.0	6.7%
Environmental Impacts					**E**	3.0	20.0%
						15	**100%**

Functional Analysis

Functional analysis results in a unique view of the project. It transforms project elements into functions, which moves the VE/PD Team mentally away from the original design and takes it toward a functional concept of the project.

Functions are defined in verb-noun statements to reduce the needs of the project to their most elemental level. Identifying the functions of the major design elements of the project allows a broader consideration of alternative ways to accomplish the functions. The major functions identified by the team were:

- Reduce Congestion
- Reduce Conflicts
- Improve Mobility
- Create Access
- Modify Access
- Span Roadways
- Minimize Impacts (Sensitive Areas)
- Create Space

FAST Diagram

The Functional Analysis System Technique or FAST diagram arranges the functions in logical order so that when read from left to right; the functions answer the question “How?” If the diagram is read from right to left, the functions answer the question “Why?” Functions connected with a vertical line are those that happen at the same time as, or are caused by, the function at the top of the column.

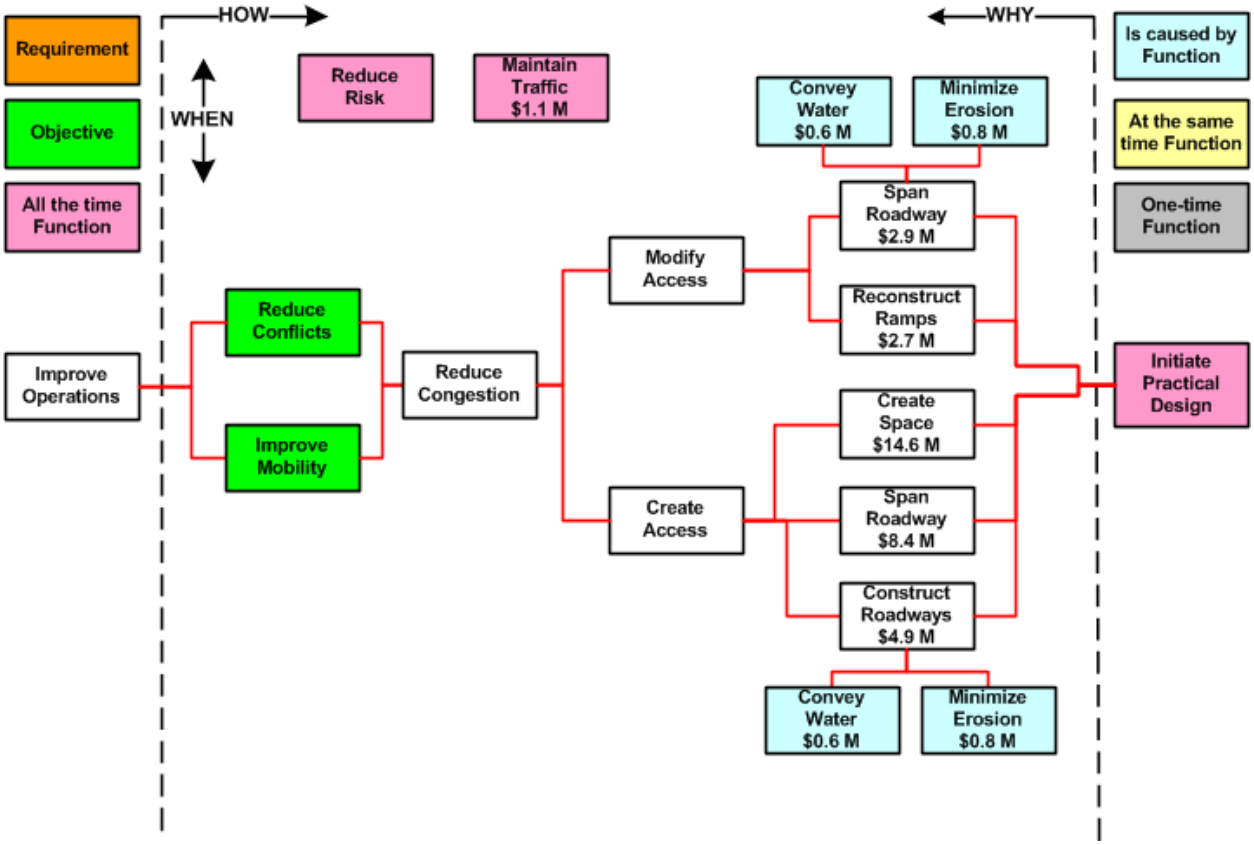

Figure 10 – FAST Diagram

The FAST Diagram for this project shows Reduce Conflicts and Improve Mobility as the basic functions of this project. The key secondary functions were Modify Access (I-5 southbound to SR 18) and Create Access (I-5 southbound to SR 161).

This provided the VE/PD Team with an understanding of the project design rationale and which functions offer the best opportunity for cost or performance improvement.

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Creative Phase

During the speculation or creative phase of the VE Job Plan, the VE/PD Team brainstormed ideas on how to achieve the various functions. These ideas were based on the available information given to them at the time of the workshop, taking into consideration the constraints and controlling decisions that were also defined for them. The ideas listed below coincide with each function being considered:

Function: Create/Modify Access (New Auxiliary Lane from I-5 to SR 18/348th Street)

- Reduce Design Speed to 60 MPH on I-5
- Shorten auxiliary lane
- Use a one lane off-ramp
- Close the south to west movement
- Dual lane taper off-ramp
- Construct a collector-distributor
- Use an 8' shoulder adjacent to auxiliary lane
- Use 11' auxiliary lane
- Widen the existing I-5 bridge to accommodate new lanes
- Do not reconstruct the ramp to westbound 348th Street
- Use the existing I-5 bridge over SR 18
- Combine the off-ramp to eastbound SR 18 with the new SR 161 ramp
- Use MSE walls (without fascia)
- Use extended guardrail posts instead of moment slab barrier
- Flatten slopes
- Eliminate the westbound off ramp and combine with loop ramp
- Eliminate the eastbound loop ramp and combine with westbound
- Direct Access from I-5 southbound to westbound 348th (center of roadway)

Function: Create/Modify Access (new I-5 Ramp to 356th Street and SR 161)

- Complete/Advance the geotechnical report
- Reduce the ramp lane width to 12'
- Reduce the left shoulder to 2'
- Connect to 352nd instead of 356th
- Use precast elements (such as columns, etc.)
- Use shorter spans
- Eliminate connection to NS-05 (SR 161)
- Don't construct the ramp to 356th
- Use a displaced left for SR 161 to 356th
- Eliminate the new ramp to SR 161 and send all vehicles to 356th
- Interconnect the new 16th signal with SR 161/356th and let the city operate the signal
- Keep a single lane right turn only from 16th to southbound SR 161
- Through and right turns only from new ramp
- Use a "Michigan Left" from SR 161 to 16th/356th

  - A Michigan left is an at-grade intersection design which replaces each left turn with a U-turn and a right turn. The design was given the name due to its frequent use along Michigan roads and highways since the late 1960s. In other contexts, the intersection is called a median U-turn crossover or median U-turn.
- Use a loop “jughandle” within the existing gas station
  - A jughandle is a type of intersection design that uses at-grade loop roads to create indirect turning movements. Similar to left-turn-only lanes, indirect turns reduce crashes, improve congestion and add capacity. Jughandles are appropriate for high-traffic intersections that have limited space to expand turn lanes.
- Construct Option C (Roundabout)
- Construct 2 roundabouts (realigned 16th and SR 161st)
- Remove signal at SR 161 and existing off-ramp to a roundabout
- Construct an oblong shaped roundabout (modified Option C)
- Coordinate all the signals along SR 161
- Cul-de-Sac 16th at 356th and construct 14th Ave from 356th to 359th
- 16th right-in/right-out and allow U-turns where needed
- Leave the access to paint store/auto shop to right-in/right-out
- Relocate fabrication to the NE quadrant of 356th and SR 161
- Option C - but make 16th right-in/right-out and construct a roundabout at Lowe’s
- Option C - make the right turn from the ramp to SR 161 a dedicated movement
- Option B1
- Option B2
- Reduce sidewalks from 8’ to 6’
- Break into 2 projects (fix 356th intersection now and construct ramp later)

Evaluation Phase

Although each project is different, the evaluation process for each value engineering effort can be thought of in its simplest form as a way of combining, evaluating, and narrowing ideas until the VE/PD Team agrees on the proposals to be forwarded.

Taking into consideration the constraints and controlling decisions, the team discussed each idea and documented the advantages and disadvantages. Each idea was then carefully evaluated with the VE/PD Team reaching consensus on the overall rating of the idea (zero through five). High-rated ideas (four or higher) were developed further; those that were considered to be equivalent to the baseline (rated three) were documented as design considerations; and low-rated ones (two or lower) were dropped from further consideration; however, the team provided a short description and justification to support the low rating. The rating values are shown below:

5 = Great Opportunity
4 = Good Opportunity
3 = Design Consideration (comparable to project team's approach)
2 = Minor Value Degradation
1 = Major Value Degradation
0 = Fatal Flaw (unacceptable impact or doesn't meet the project purpose and need)

= Advanced as recommendation

= Forwarded as design consideration

= Dropped from future consideration

Function: Create/Modify Access (I-5 Ramp to SR 18/348th Street westbound and SR 161)

#	Description	Advantages	Disadvantages
MA-1	Reduce Design Speed to 60 MPH on I-5	▪ Shorten deceleration lengths into ramps	▪ Driver expectancy ▪ Trucks will find it hard to slow down

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎				

Rating: 2	Justification/Comments/Disposition:
	Minimal savings for shortening the deceleration length. Dropped from further consideration.

#	Description	Advantages	Disadvantages
MA-2	Shorten auxiliary lane	▪ Reduce cost ▪ Reduces impacts to wetlands/creek	▪ May create problems in conveying stormwater to ponds

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎		👍	👍	👍

Rating:	Justification/Comments/Disposition:
2	*This idea was dropped from further consideration.*

#	Description	Advantages	Disadvantages
MA-3	Use a one lane off-ramp (The auxiliary lane could be delayed until a future phase when needed)	▪ Reduces cost ▪ Reduces impacts to wetlands/creek	▪ May create problems in conveying stormwater to ponds ▪ Does not improve Mainline Operations ▪ To much volume to combine into a single lane off-ramp

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎		👍	👍	👍

Rating:	Justification/Comments/Disposition:
1	*This idea was dropped from further consideration.*

#	Description	Advantages	Disadvantages
MA-4	Close the south to west movement	▪ None noted	▪ Reduce capacity

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
0	*Does not meet the purpose and need of the project.*

#	Description	Advantages	Disadvantages
MA-5	Dual lane taper off-ramp	▪ Reduces cost ▪ Reduces impacts to wetlands/creek	▪ May create problems in conveying stormwater to ponds

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎				

Rating: 2	Justification/Comments/Disposition:
	This idea was dropped from further consideration.

#	Description	Advantages	Disadvantages
MA-6	Construct a collector-distributor	▪ Eliminates one access point on I-5	▪ May need to increase the bridge over SR 18 to two lanes ▪ Increases cost

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👍		👎		👍

Rating: 2	Justification/Comments/Disposition:
	This idea was dropped from further consideration.

#	Description	Advantages	Disadvantages
MA-7	Use an 8’ shoulder adjacent to auxiliary lane	▪ Reduces impervious pavement ▪ Reduces cost ▪ Reduces sensitive area impacts	▪ Potentially reduces area for maintenance and enforcement ▪ Disabled vehicles will shy away from guardrail

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
		👍👎		👍

Rating: 3	Justification/Comments/Disposition:
	Maybe combined with MA-8 - This idea was combined with other ideas as part of Recommendation No. 1

#	Description	Advantages	Disadvantages
MA-8	Use 11' auxiliary lane	▪ Reduces impervious pavement ▪ Reduces cost ▪ Reduces sensitive area impacts	▪ None noted

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
		👍		👍

Rating: 4	Justification/Comments/Disposition:
	This idea was combined with other ideas as part of Recommendation No. 1

#	Description	Advantages	Disadvantages
MA-9	Widen the existing I-5 bridge to accommodate the new lanes	▪ Reduces footprint ▪ Reduces cost	▪ None noted

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating: 4	Justification/Comments/Disposition:
	Current bridge doesn't meet current design standards for vertical clearance. After further development this idea was changed to a design consideration

#	Description	Advantages	Disadvantages
MA-10	Do not reconstruct the ramp to westbound 348th Street	▪ Reduces cost	▪ Ramp does not meet design standards for sight distance, etc.

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎			👍	

Rating: 4	Justification/Comments/Disposition:
	May be able to clear some brush and regrade the inside of the old loop ramp to improve sight distance. After further development this idea was changed to a design consideration.

#	Description	Advantages	Disadvantages
MA-11	Use the existing I-5 bridge over SR 18	▪ Reduces cost	▪ Does not provide adequate width

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎				

Rating: 1	Justification/Comments/Disposition:
	This idea was dropped from further consideration.

#	Description	Advantages	Disadvantages
MA-12	Combine the off-ramp to eastbound SR 18 with the new SR 161 ramp	▪ Reduces cost	▪ Speed differential between the 2 ramps (slower loop ramp with faster traffic) ▪ May be over capacity

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎		👍	👍	👍

Rating:	Justification/Comments/Disposition:
1	*This idea was dropped from further consideration.*

#	Description	Advantages	Disadvantages
MA-13	Use MSE walls (without fascia) along auxiliary lane widening	▪ Reduces footprint ▪ Reduces impacts to sensitive area ▪ May reduce cost	▪ None noted

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
3	*Design Consideration if it saves $$*

#	Description	Advantages	Disadvantages
MA-14	Use extended guardrail posts instead of moment slab barrier	▪ Reduces cost	▪ May add to maintenance problems

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
		👎	👍	

Rating:	Justification/Comments/Disposition:
4	*Use nested rail or thrie beam across the culvert head wall to eliminate the need for moment slab. This idea was developed further as Recommendation No. 2*

#	Description	Advantages	Disadvantages
MA-15	Flatten slopes along auxiliary lane	▪ Avoid an engineered fill section or wall	▪ Existing 2:1 slope makes it unpractical to catch ▪ Increases impacts to sensitive areas

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
		👍		👎

Rating: 1	Justification/Comments/Disposition:
	This idea was dropped from further consideration.

#	Description	Advantages	Disadvantages
MA-16	Eliminate the westbound off ramp and the new SR 161 ramp. Combine with loop ramp (Parclo)	▪ Significant cost reduction	▪ Will need to increase the number of lanes of the loop ramp ▪ Will queue onto I-5 ▪ Delays on eastbound SR 18 that don't occur now

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎	👎		👍	👍👎

Rating: 1	Justification/Comments/Disposition:
	This idea was dropped from further consideration.

#	Description	Advantages	Disadvantages
MA-17	Eliminate the eastbound loop ramp and combine with westbound	▪ Reduces footprint ▪ Significant cost reduction ▪ Eliminates the need for bridge over SR 18 ▪ Provides a better transition between freeway and arterial street ▪ Eliminates the merge point on SR 18	▪ Delays on eastbound SR 18 that don't occur now ▪ Traffic may queue back onto SR 18

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👍👎	👍👎	👍	👍	👍

Rating: 4	Justification/Comments/Disposition:
	This idea was developed further as Recommendation No. 4

#	Description	Advantages	Disadvantages
MA-18	Direct Access from I-5 southbound to westbound 348th (center of roadway)	▪ None noted	▪ Increased costs ▪ Added bridge

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating: 1	Justification/Comments/Disposition:
	This idea was dropped from further consideration.

#	Description	Advantages	Disadvantages
MA-19	Reduce all of I-5 to 11' lanes (or a combination of 11' and 12') through this area to minimize the needed widening for the auxiliary lane and other items	▪ Reduces impervious pavement ▪ Reduces cost ▪ Reduces sensitive area impacts	▪ There is a crown in the middle of I-5 that makes it difficult to reduce the lane width across the interstate

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👎		👍	👍	👍

Rating: 3	Justification/Comments/Disposition:
	This idea was added during the evaluation phase - Combine with other ideas as needed – Design Consideration

Function: Create/Modify Access (new ramp to 356th and SR 161)

#	Description	Advantages	Disadvantages
CA-1	Complete/Advance the geotechnical report	▪	▪

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
	Baseline – the borings have already been completed the draft report is pending

#	Description	Advantages	Disadvantages
CA-2	Reduce the SR 161 ramp lane width from 15' to 12'	▪ Significant cost reduction ▪ Reduces impacts to sensitive areas	▪ Reduced the available roadway width for disabled vehicle

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👍👎		👍		👍

Rating:	Justification/Comments/Disposition:
4	*This idea was combined with other ideas as part of Recommendation No. 1*

#	Description	Advantages	Disadvantages
CA-3	Reduce the SR 161 ramp left shoulder to 2'	▪ Significant cost reduction ▪ Reduces impacts to sensitive areas	▪ Reduces the available roadway width for disabled vehicle

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
4	*May be combined with CA-2*

#	Description	Advantages	Disadvantages
CA-4	Connect to 352nd instead of 356th	▪ Reduces cost	▪ Does not meet needs for future growth ▪ Impacts to Costco and Home Depot

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👎	👍		👍

Rating:	Justification/Comments/Disposition:
1	*This idea was dropped from further consideration.*

#	Description	Advantages	Disadvantages
CA-5	Use precast elements (such as columns, etc.) to construct bridges	▪ Shortens construction duration	▪ None noted

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
			👍	

Rating:	Justification/Comments/Disposition:
3	*Design Consideration*

#	Description	Advantages	Disadvantages
CA-6	Reduce the span lengths of the bridges	▪ May reduce cost	▪ May increase cost

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating: 3	Justification/Comments/Disposition:
	Design Consideration

#	Description	Advantages	Disadvantages
CA-7	Eliminate connection to NS-05 (SR 161)	▪ Reduces cost ▪ Reduce impacts to sensitive areas	▪ May need dual lefts at SR 161

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
		👍		👍

Rating: 4	Justification/Comments/Disposition:
	After further development this idea was dropped from further consideration.

#	Description	Advantages	Disadvantages
CA-8	Don't construct the ramp to 356th, connect to existing ramp and expand intersection	▪ Significant cost reduction (ROW) ▪ Reduces impacts to businesses	▪ Increases turning movements along SR 161

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👎	👍	👍	👍

Rating: 4	Justification/Comments/Disposition:
	After further development this idea was dropped from further consideration..

#	Description	Advantages	Disadvantages
CA-9	Use a displaced left for SR 161 to 356th	▪ Improves the turning movement from SR 161 to 356th	▪ May need some minor widening along SR 161

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating: 4	Justification/Comments/Disposition:
	Combine with CA-8 – After further development this idea was dropped to a Design Consideration

#	Description	Advantages	Disadvantages
CA-10	Eliminate the new ramp to SR 161 and send all vehicles to 356th	▪ Removes impervious surface ▪ Removes a signal from SR 161	▪ The end of the new ramp would now be considered "throw away" ▪ May reduce capacity along SR 161

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
				

Rating:	Justification/Comments/Disposition:
3	*Design Consideration*

#	Description	Advantages	Disadvantages
CA-11	Interconnect the new 16th signal with SR 161/356th and let the city operate the signal	▪ City will be better able to coordinate the timing of the signals	▪ None noted

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
5	*WSDOT must own the signal but will enter into an operations agreement for the city to operate. Expand to include all needed signals. This idea was moved forward to further development as Recommendation No. 3*

#	Description	Advantages	Disadvantages
CA-12	Keep a single lane right turn only from 16th to southbound SR 161	▪	▪

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
3	*Combine with other ideas as needed*

#	Description	Advantages	Disadvantages
CA-13	Through and right turns only from new ramp	▪ May reduce signal timing ▪ May reduce some impervious surface	▪ None noted

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
4	*After further development this idea was moved to a Design Consideration*

#	Description	Advantages	Disadvantages
CA-14	Use a ”Michigan Left” from SR 161 to 16th/356th	▪ Moves left turn away from intersection ▪ Reduces delay	▪ Driver expectancy ▪ Additional access control ▪ May increase cost

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👍			

Rating:	Justification/Comments/Disposition:
4	*Evaluate this idea with CA-9. After further development this idea was moved to a Design Consideration.*

#	Description	Advantages	Disadvantages
CA-15	Use a loop “jughandle” within the existing gas station	▪ Moves left turn away from intersection ▪ Reduces intersection delay	▪ Driver expectancy ▪ Increased cost ▪ Combines off-ramp traffic with SR 161 ▪ Increases impervious surface

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👎👍	👎		👍

Rating:	Justification/Comments/Disposition:
3	*Design Consideration*

#	Description	Advantages	Disadvantages
CA-16	Construct Option C (Roundabout)	▪ Reduces intersection delay ▪ Reduces conflicts ▪ Eliminates a signal ▪ Better shared space ▪ Reduces right-of way needed ▪ Provides u-turns	▪ Pedestrian crossing ▪ Impacts during construction ▪ Impacts to driveways along 16th

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👍		👎	👍

Rating:	Justification/Comments/Disposition:
4	*This idea was moved forward to further development as Recommendation No. 5*

#	Description	Advantages	Disadvantages
CA-17	Construct 2 roundabouts (realign 16th and SR 161st)	▪ Reduces intersection delay ▪ Reduces conflicts ▪ Eliminates a signal ▪ Better shared space ▪ Provides u-turns	▪ Significant cost increase

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👍		👎	

Rating:	Justification/Comments/Disposition:
3	*Combine with other roundabout ideas as needed*

#	Description	Advantages	Disadvantages
CA-18	Remove signal at SR 161 and existing off-ramp and convert to a roundabout	▪ Reduces intersection delay ▪ Reduces conflicts ▪ Eliminates a signal ▪ Better shared space ▪ Provides u-turns	▪ Significant cost increase ▪ Geometric issues

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👍		👎	👎

Rating:	Justification/Comments/Disposition:
3	*May be feasible if combined with CA-8*

#	Description	Advantages	Disadvantages
CA-19	Construct an oblong shaped roundabout (modified Option C)	▪ Reduces intersection delay ▪ Reduces conflicts ▪ Eliminates a signal ▪ Better shared space ▪ Provides u-turns	▪ Unknown without design

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
			👎	

Rating:	Justification/Comments/Disposition:
3	*Design Consideration*

#	Description	Advantages	Disadvantages
CA-20	Coordinate all the signals along SR 161	▪	▪

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
3	*Combine with CA-11*

#	Description	Advantages	Disadvantages
CA-21	Cul-de-Sac 16th at 356th and construct 14th Ave from 356th to 359th	▪ Reduces right-of-way costs ▪ Moves traffic away from SR 161	▪ Outside of the footprint of the environmental document ▪ Local opposition

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👍			👍👎

Rating:	Justification/Comments/Disposition:
3	*Design Consideration*

#	Description	Advantages	Disadvantages
CA-22	16th right-in/right-out and allow U-turns were needed	▪ Reduces construction impacts	▪ Would create longer routes for buses

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👎		👍	

Rating:	Justification/Comments/Disposition:
1	*This idea was dropped from further consideration.*

#	Description	Advantages	Disadvantages
CA-23	Leave the access to paint store/auto shop to right-in/right/out	▪ Reduces right-of-way costs	▪ Leaves access

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
				

Rating:	Justification/Comments/Disposition:
4	*This idea was moved forward to further development as Recommendation No. 6*

#	Description	Advantages	Disadvantages
CA-24	Relocate the fabrication shop to the NE quadrant of 356th and SR 161	▪ Use of property that WSDOT already owns	▪

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
				

Rating:	Justification/Comments/Disposition:
3	*Design Consideration*

#	Description	Advantages	Disadvantages
CA-25	Option C - but make 16th right-in/right-out and construct a roundabout at Lowe's	▪ Reduces intersection delay ▪ Reduces conflicts ▪ Eliminates a signal ▪ Better shared space ▪ Provides u-turns	▪ Significant cost increase

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
3	*Combine with other roundabout ideas as needed – Design Consideration*

#	Description	Advantages	Disadvantages
CA-26	Option C - make the right turn from the ramp to SR 161 a dedicated movement	▪ Reduces intersection delay ▪ Reduces conflicts ▪ Eliminates a signal ▪ Better shared space ▪ Provides u-turns	▪ Significant cost increase

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating: 3	Justification/Comments/Disposition:
	Combine with other roundabout ideas as needed – Design Consideration

#	Description	Advantages	Disadvantages
CA-27	Construct Option B1	▪ Has a lower impact on the traveling public during construction ▪ Should improve the level of service at the S. 356th St/SR 161 intersection by reducing turning movements	▪ Impacts several occupied residential properties. ▪ Reduces the level of service at the ramp terminal at the vicinity of S. 359th St. ▪ Has not been discussed with the city of Federal Way. The city may be concerned about the grade as this road would be the primary access to a high school

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👎		👍	👎

Rating: 2	Justification/Comments/Disposition:
	This idea was dropped from further consideration.

#	Description	Advantages	Disadvantages
CA-28	Construct Option B2	▪ Has a lower impact on the traveling public during construction ▪ Should improve the level of service at the S. 356th St/SR 161 intersection by reducing turning movements	▪ Impacts several occupied residential properties. ▪ Reduces the level of service at the ramp terminal at the vicinity of S. 359th St. ▪ Has not been discussed with the city of Federal Way. The city may be concerned about the grade as this road would be the primary access to a high school

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👎		👍	👎

Rating:	Justification/Comments/Disposition:
2	*This idea was dropped from further consideration.*

#	Description	Advantages	Disadvantages
CA-29	Reduce sidewalks from 8' to 6' on 16th Avenue	▪ Reduces footprint ▪ Reduces costs	▪ None noted

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
		👍	👍	👍

Rating:	Justification/Comments/Disposition:
4	*This idea was combined with other ideas as part of Recommendation No. 1*

#	Description	Advantages	Disadvantages
CA-30	Break into 2 projects (fix 356th intersection now and construct ramp later)	▪ May be able to create a project that can be funded	▪ Historically may not be feasible

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts

Rating:	Justification/Comments/Disposition:
3	*Design Consideration*

#	Description	Advantages	Disadvantages
CA-31	Modify the accesses to allow businesses to remain open	▪ Reduces cost	▪ May require higher approvals ▪ Increase congestion ▪ Increases conflict points

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
	👎			👍

Rating: 4	Justification/Comments/Disposition:
	This idea was moved forward to further development as Recommendation No. 6

#	Description	Advantages	Disadvantages
CA-32	Construct the ramp terminal further east down the new ramp	▪ Ends the ramp sooner allowing a change in access ▪ Reduces right-of-way costs	▪ Adds a left turn movement at the intersection

Mainline Operations	Local Operations	Maintainability	Construction Impacts	Environmental Impacts
👍	👍			👍

Rating: 4	Justification/Comments/Disposition:
	This idea was moved forward to further development as Recommendation No. 7

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Development Phase

The VE Recommendations are presented as written by the team during the VE/PD Workshop. While they have been edited for the VE/PD report to correct errors or better clarify the recommendation, they represent the VE/PD Team's findings during the VE/PD Workshop. The following table is a summary of all recommendations generated and their impact to the project.

Table 6 - Summary of Recommendations (millions $)

#	Description	Construction Savings (Added)	Right-of-Way Savings	Performance
1	Reduce Widths	$3.10		7%
2	Nested Guardrail	$0.06		5%
3	Signal Operations			21%
4	Southbound I-5 to Eastbound SR 18	$6.76		18%
5	Roundabout @ 356th	($1.26)	$3.07	40%
6	Access Control		$4.08	2%
7	Ramp Terminal	($1.60)	$8.16	42%
	Total	**$8.66**	**$7.15 - $11.23**	

The cost comparisons reflect a difference or delta between the baseline idea and the VE Recommendation. As the project progresses, these values can be updated to reflect actual implemented results.

These values shown have been adjusted by 100% to reflect the additional ***cumulative*** costs of miscellaneous item allowance, mobilization, sales tax, contingency, preliminary engineering and construction administration costs. See the Effective Markup shown in Table 2 (from the provided cost estimate):

Performance Assessment

As the VE/PD Team develops recommendations; the performance of each is rated against the baseline concept. Changes in performance are always based upon the overall impact to the total project. Once performance and cost data have been developed by the VE/PD Team, the net change in value of the VE recommendations can be compared to the baseline concept.

For this exercise the baseline was given a score of 5. The resulting value improvement scores provide a way for WSDOT to assess the potential impact of the VE/PD recommendations on total project value.

Table 7 – Value Matrix

Attribute	Attribute Weight	Recommendation	Performance Rating										Total Performance
			1	2	3	4	5	6	7	8	9	10	
Mainline Operations	26.7	Baseline					5						133
		1					5						133
		2					5						133
		3						6					160
		4					5						133
		5						6					160
		6					5						133
		7						6					160
Local Operations	30.0	Baseline					5						150
		1					5						150
		2					5						150
		3							7				210
		4					5						150
		5								8			240
		6				4							120
		7								8			240
Maintainability	16.7	Baseline					5						83
		1						6					100
		2				4							67
		3					5						83
		4								8			133
		5								8			133
		6					5						83
		7							7				117
Construction Impacts	6.7	Baseline					5						33
		1					5						33
		2								8			53
		3					5						33
		4								8			53
		5				4							27
		6					5						33
		7					5						33
Environmental Impacts	20.0	Baseline					5						100
		1						6					120
		2						6					120
		3						6					120
		4						6					120
		5							7				140
		6							7				140
		7								8			160

Understanding the relationship of cost, performance, and value of the project baseline and VE recommendations is essential in evaluating VE recommendations. Comparing the performance and cost suggests which recommendations are potentially as good as or better than the project baseline concept in terms of overall value.

Table 8 – Value Improvement

	Recommendation	Performance (P)	% Change Performance	Cost (C) $ millions	% Change Cost	Easy to Implement	% Value Index	% Value Improvement
	Baseline	500	N/A	$60.0	N/A	5	41.67	N/A
1	Reduce Widths	537	7%	$53.8	10%	5	49.89	20%
2	Nested Guardrail	523	5%	$59.9	0%	7	61.19	47%
3	Signal Operations	607	21%	$60.0	0%	5	50.56	21%
4	Southbound I-5 to Eastbound SR 18	590	18%	$46.5	23%	4	50.79	22%
5	Roundabout @ 356th	700	40%	$56.4	6%	7	86.93	109%
6	Access Control	510	2%	$51.8	14%	7	68.88	65%
7	Ramp Terminal	710	42%	$46.9	22%	5	75.74	82%

Design Considerations

In addition to the recommendations above, the VE/PD Team generated a number of considerations they felt were important enough to be documented and should be further considered by the project team.

- Widen the existing I-5 bridge to accommodate the new lanes
- Do not reconstruct the ramp to westbound 348th Street
- Use MSE walls (without fascia) along auxiliary lane widening
- Reduce all of I-5 to 11’ lanes (or a combination of 11’ and 12’) through this area to minimize the needed widening for the auxiliary lane and other items
- Use precast elements (such as columns, etc.) to construct bridges
- Reduce the span lengths of the bridges
- Use a displaced left for SR 161 to 356th
- Eliminate the new ramp to SR 161 and send all vehicles to 356th
- Keep a single lane right turn only from 16th to southbound SR 161
- Through and right turns only from new ramp
- Use a Median U-turn from SR 161 to 16th/356th
- Use a loop “jughandle” within the existing gas station
- Construct 2 roundabouts (realigned 16th and SR 161st)
- Remove signal at SR 161 and existing off-ramp and convert to a roundabout
- Construct an oblong shaped roundabout (modified Option C)

- Coordinate all the signals along SR 161
- Cul-de-Sac 16th at 356th and construct 14th Ave from 356th to 359th
- Relocate the fabrication shop to the NE quadrant of 356th and SR 161
- Option C - but make 16th right-in/right-out and construct a roundabout at Lowe's
- Option C - make the right turn from the ramp to SR 161 a dedicated movement
- Break into 2 projects (fix 356th intersection now and construct ramp later)

FHWA Functional Benefit Criteria

Each year, State DOT's are required to report on VE Recommendations to FHWA. In addition to cost implications, FHWA requires the DOT's to evaluate each approved recommendation in terms of the project feature or features that recommendation benefits. If a specific recommendation can be shown to provide benefit to more than one feature described below, count the recommendation in *each category that is applicable*. These same criteria can be found on each of the individual recommendations that follow.

- **Safety:** Recommendations that mitigate or reduce hazards on the facility.
- **Operations:** Recommendations that improve real-time service and/or local, corridor, or regional levels of service of the facility.
- **Environment:** Recommendations that successfully avoid or mitigate impacts to natural and or cultural resources.
- **Construction:** Recommendations that improve work zone conditions, or expedite the project delivery.
- **Other:** Recommendations not readily categorized by the above performance indicators.

Value Engineering Recommendation Approval

The VE Recommendation form is to aid in annual reporting of VE activities to FHWA. It is the intent that the project manager review and evaluate the VE/PD Team's alternatives included in the VE/PD report. The project manager would then complete the Recommendation Approval form shown in the Appendix.

Each alternative that is not approved or is modified by the project manager should include a justification (a summary statement containing the project manager's decision not to use the recommendation in the project).

The completed Value Engineering Recommendation Approval form, including justification for any recommendations not approved or modified, shall be sent to the WSDOT State Value Engineer so the results can be included in the annual VE Report to the Federal Highway Administration (FHWA).

Recommendations

Based on the evaluation process, individual recommendations were developed. Each recommendation consists of a summary of the original concept, a description of the suggested change, a listing of its advantages and disadvantages, and a brief narrative that includes justification, sketches, photos, assumptions and calculations (where applicable) as developed by the VE/PD Team.

Recommendation No. 1 Reduce Widths	IDEA NO. MA-7, MA-8, CA-2, CA-3, CA-29

Baseline

The auxiliary lane for the southbound I-5 off-ramp to SR 18 is 12' wide and has a 10' outside shoulder.

The off-ramp from I-5 to the SR 161/356th Street intersection has a typical section consisting of a 4' inside shoulder, a 15' lane and an 8' outside shoulder.

The baseline design has 8' wide sidewalks.

Recommendation

The VE/PD Team recommends the auxiliary lane and outside shoulder be reduced to 11' and 8' respectively.

The off-ramp from I-5 to the SR 161/356th Street intersection can be reduced by 5' by using a 2' inside shoulder and a 12' lane.

Reduce the sidewalks to 6' wide.

Advantages	Disadvantages
• Reduces impervious pavement • Significant cost reduction • Reduces sensitive area impacts	• Potentially reduces parking area for maintenance and enforcement • Disabled vehicles may shy away from guardrail and encroach upon the lane • May require an update to the environmental documentation and commitments.

Summary of Cost Analysis

	Cost
Baseline	N/Q
Recommendation	N/Q
Difference	$1.55 M x 100% markup = $3.10 M

FHWA Functional Benefit

Safety	Operations	Environment	Construction	Other
		✓		✓

WSDOT Practical Design		
	Lowers Cost	Yes
	Easy to Implement	Moderate

Recommendation No. 1 Reduce Widths	IDEA NO. MA-7, MA-8, CA-2, CA-3, CA-29

Comments/Justification

The baseline for the auxiliary lane is shown in the figure below.

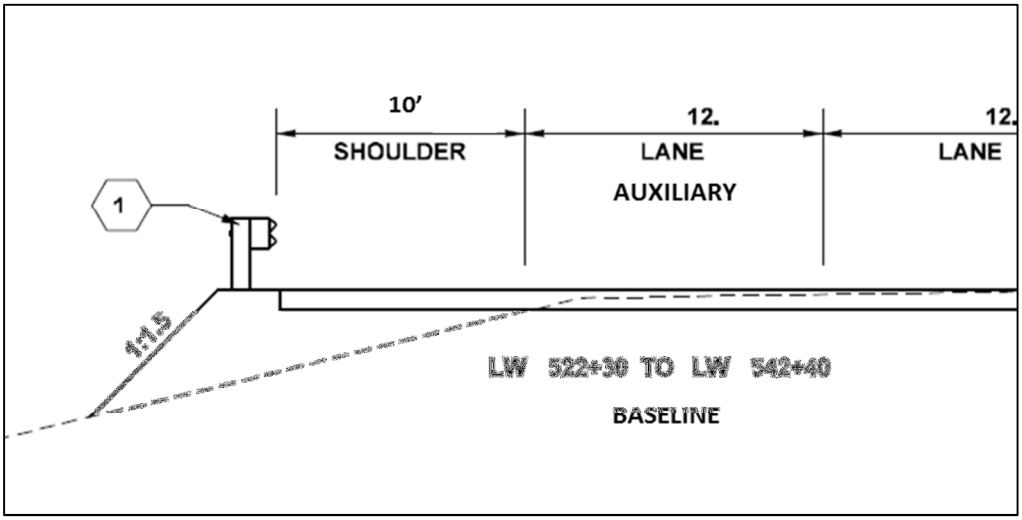

Figure 11 – Baseline Auxiliary Lane

The VE/PD recommendation is to reduce the auxiliary lane to 11' and its shoulder to 8'.

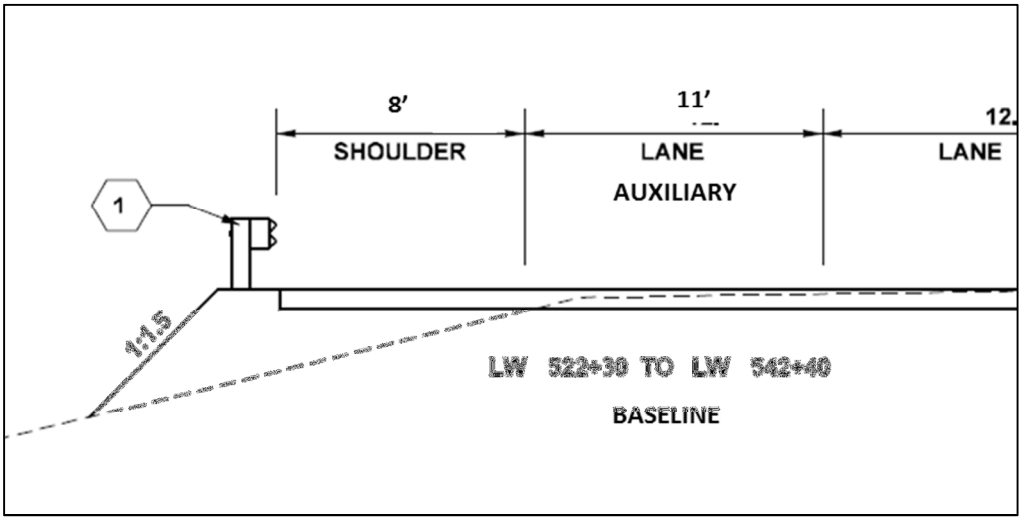

Figure 12 – VE/PD Auxiliary Lane

Utilizing this configuration for the length of the auxiliary lane will reduce construction costs through a reduction in paving quantities and embankment.

The use of 11' lanes will not reduce operational capacity and is consistent with other lanes within the I-5 corridor.

Recommendation No. 1 Reduce Widths	IDEA NO. MA-7, MA-8, CA-2, CA-3, CA-29

The baseline for the off-ramp to SR 161 and 356th is shown in the following figure.

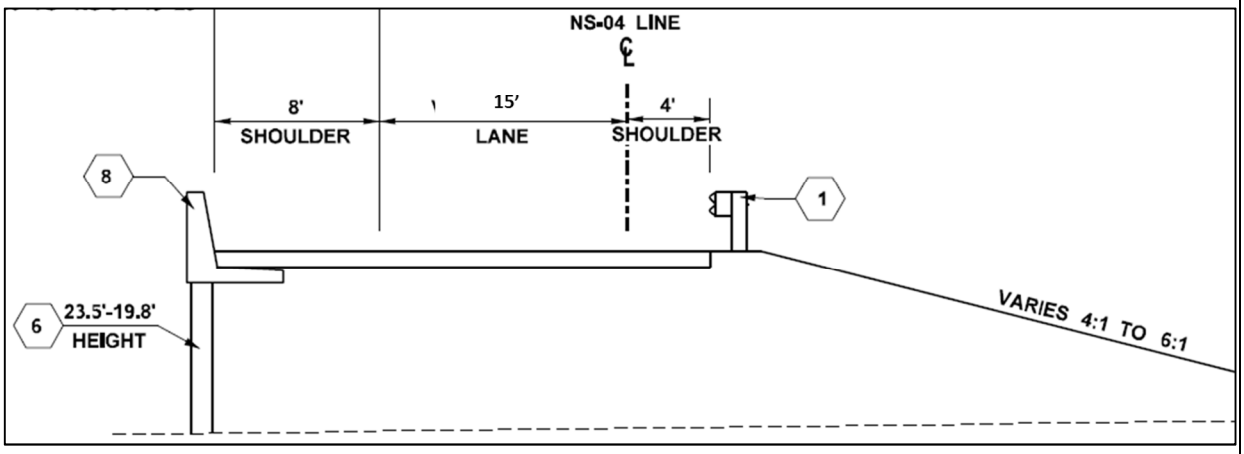

Figure 13 – Baseline Ramp

The VE/PD recommendation is to reduce the 4' shoulder to 2' and the lane width from 15' to 12'.

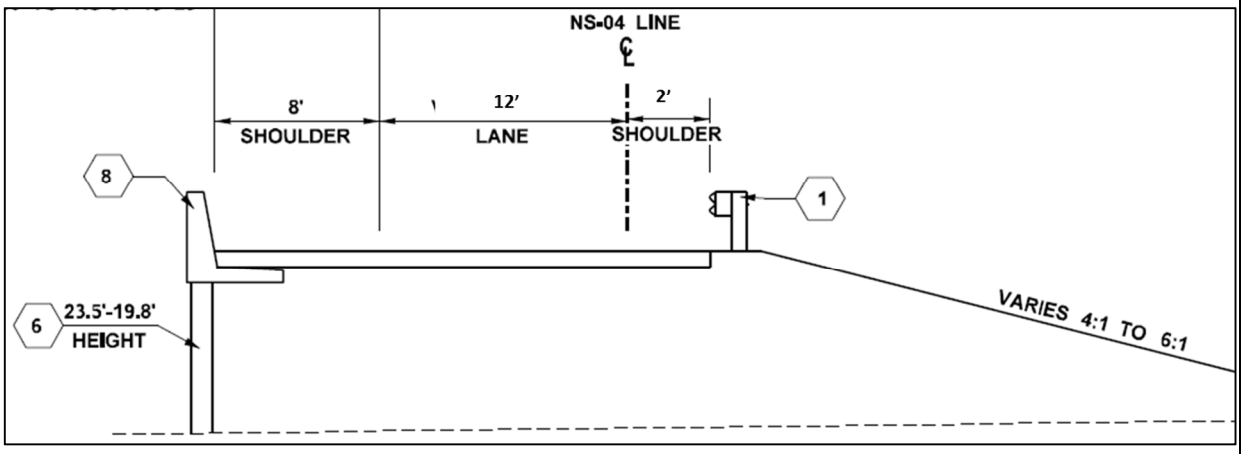

Figure 14 – VE/PD Ramp

Utilizing this configuration for the length of the ramp will reduce construction costs through a reduction in paving quantities, embankment and bridge costs.

Reducing the lane and shoulder widths will not reduce operational capacity and still provides enough room for cars to navigate any stalled or disabled vehicle that occupies the 8' shoulder.

Reduce the width of sidewalks from 8' to 6' on 16th Avenue. A 5' bike lane is being provided on all the local roadways adjacent to all sidewalks.

Recommendation No. 1 Reduce Widths	IDEA NO. MA-7, MA-8, CA-2, CA-3, CA-29

Assumptions/Calculations

Auxiliary lane length = 540+00 – 525+00 = 1,500 LF

PCCP = 1,500 LF x 12" depth x 1' width = 1,500 CF
1,500 CF/ 27 = 56 CY x $270/CY = $15,120

HMA = 1,500 LF x 12" depth x 2' width = 3,000 SF
3,000 CF/ 27 x 2.05 tons/CY = 228 Tons x $76/Tons = $17,328

Surfacing = 1,500 LF x 6" x 3' width = 2,250 CF
2,250 CF/27 x 1.85 tons/CY = 154 tons x $14/Ton = $2,156

Embankment = (1,500 LF x 20' high x 3' wide)/27 = 3,333 CY x $3/CY = $9,999
Total savings = $44,603

Ramp length = 49+00 – 25+00 = 2,400 LF (Bridge = 725 LF, Roadway = 1,675 LF

Bridge = 725 LF x 5' width = 3,625 SF x $300/SF = $1,087,500

HMA = 1,675 LF x 12" depth x 5' width = 8,375 SF
8,375 CF/ 27 x 2.05 tons/CY = 636 Tons x $76/Tons = $48,336

Surfacing = 1,675 LF x 6" x 5' width = 4,188 CF
4,188 CF/27 x 1.85 tons/CY = 287 tons x $14/Ton = $4,018

Embankment = (1,675 LF x 10' high x 5' wide)/27 = 3,102 CY x $3/CY = $9,306
Total savings = $1,149,160

Additional savings can come from converting the PCCP to HMA with in the project. This will save an additional $340 K on the project.

Sidewalk reduction = 1,844 SY * (2' reduction/8) = 461 SY x $35/SY x $16,135
44,603 + $340,000 + $1,149,160 + $16,135 = $1,549,898

Recommendation No. 1 Reduce Widths			IDEA NO. MA-7, MA-8, CA-2, CA-3, CA-29
Performance Measures			
Attributes and Rating Rationale for Recommendation	**Performance**	**Baseline**	**Recommendation**
Mainline Operations • No loss to operations	Rating	5	5
	Weight	26.7	
	Contribution	133	133
Local Operations • No change to baseline	Rating	5	5
	Weight	30.0	
	Contribution	150	150
Maintainability • Slight reduction in roadway and bridge to maintain	Rating	5	6
	Weight	16.7	
	Contribution	83	100
Construction Impacts • No change to baseline	Rating	5	5
	Weight	6.7	
	Contribution	33	33
Environmental Impacts • Reduces impacts to sensitive areas	Rating	5	6
	Weight	20.0	
	Contribution	100	120
Total Performance:		**500**	**537**
Net Change in Performance:			**7%**

Recommendation No. 2 Nested Guardrail	IDEA NO. MA-14

Baseline

Construct moment slab barrier above the culvert headwall and the adjacent steep slopes.

Recommendation

Replace the moment slab barrier with nested guardrail over culvert. Refer to WSDOT standard plan C-2k.

Advantages	Disadvantages
• Reduces cost • Reduces construction impact.	• May add to lifecycle maintenance.

Summary of Cost Analysis

	Cost
Baseline	$0.04 M
Recommendation	$0.01 M
Difference	$0.03 M x 100% markup = $0.06 M

FHWA Functional Benefit

Safety	Operations	Environment	Construction	Other
				✓

WSDOT Practical Design	**Lowers Cost**	**Yes**
	Easy to Implement	**Easy**

Recommendation No. 2 Nested Guardrail	IDEA NO. MA-14

Comments/Justification

The baseline condition includes construction of a concrete barrier mounted to a concrete moment slab. The purpose of this concrete barrier is to prevent errant vehicles from going down a steep slope at the headwall of a small (approx. 48") culvert. The purpose of the moment slab is to provide a large enough anchor to prevent the concrete barrier from rotating backwards if struck by an errant vehicle.

The VE Recommendation is to use nested guardrail (multiple layers of metal railing) as shown in WSDOT standard plan sheet C-2k.

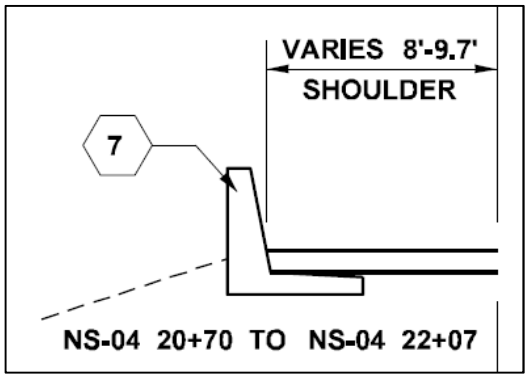

Figure 15 – Moment Slab Barrier

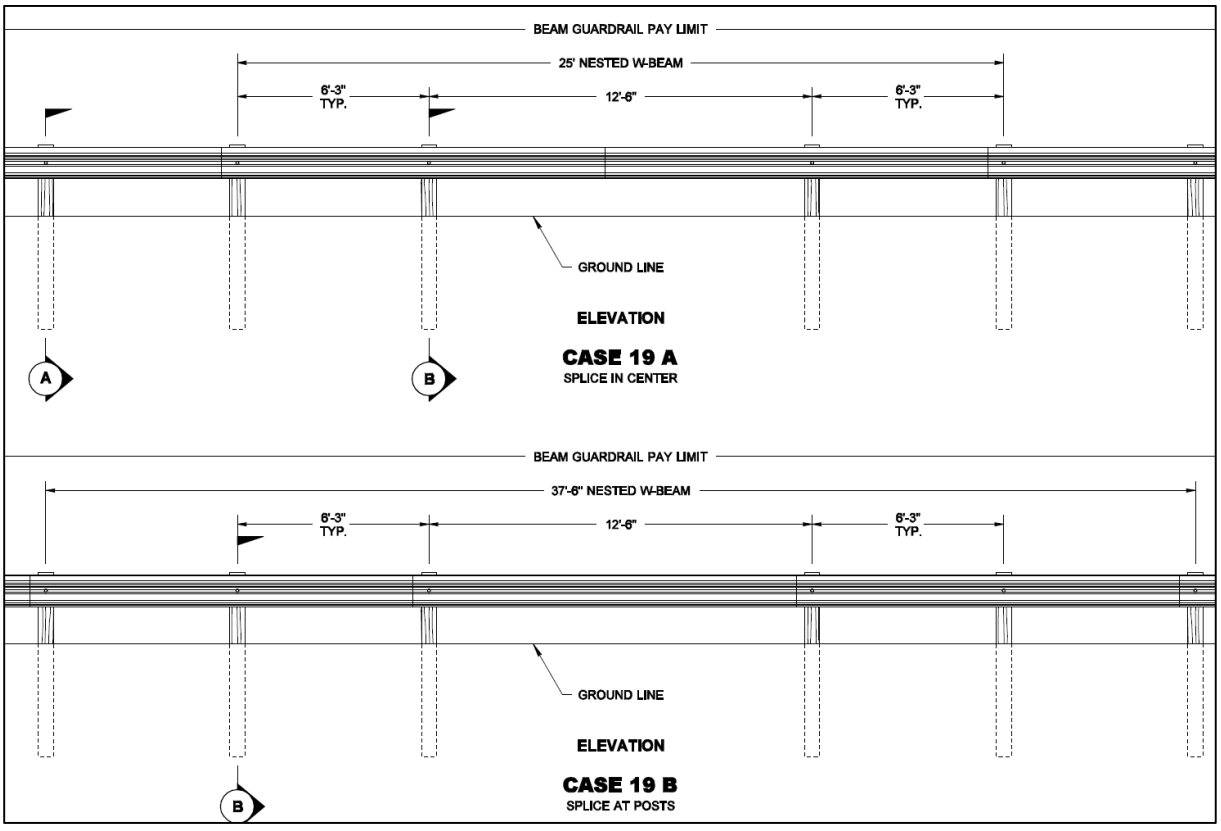

Figure 16 – Portion of WSDOT Standard Plan C-2k

Recommendation No. 2 Nested Guardrail	IDEA NO. MA-14

Assumptions/Calculations

The culvert headwall width is approximately 8 ft.

The baseline cost for 136 feet of concrete railing anchored in a moment slab is approximately $300/LF for 136 feet for a total cost of $40,800.

Using guardrail instead of the moment slab barrier as shown in standard plan C-2k will reduce the cost per linear foot to around $100 for a total of $13,600 for this work.

The net savings for this recommendation is $40,800 less $13,600 = $27,200 plus applicable mark ups.

It is worth noting that based on recent cost history; a more appropriate unit cost for the moment slab is actually $500/ft. Based on this information, the actual cost savings would increase by approximately $27,000 for an approximate total savings of $54,000 plus applicable mark ups.

Recommendation No. 2 Nested Guardrail			IDEA NO. MA-14
Performance Measures			
Attributes and Rating Rationale for Recommendation	**Performance**	**Baseline**	**Recommendation**
Mainline Operations • Operation is not impacted by the type of barrier	Rating	5	5
	Weight	26.7	
	Contribution	133	133
Local Operations • NA	Rating	5	5
	Weight	30.0	
	Contribution	150	150
Maintainability • Standard maintenance may be required frequently	Rating	5	4
	Weight	16.7	
	Contribution	83	67
Construction Impacts • Guardrail installation takes less time and effort than building moment slab.	Rating	5	8
	Weight	6.7	
	Contribution	33	53
Environmental Impacts • Eliminate potential for concrete wastewater entering sensitive areas.	Rating	5	6
	Weight	20.0	
	Contribution	100	120
Total Performance:		**500**	**523**
Net Change in Performance:			**5%**

Recommendation No. 3 Signal Operations	IDEA NO. CA-11 & CA 20

Baseline

WSDOT owns and controls traffic signals at ramp terminals; City owns and operates all other traffic signals west of I-5 and these are interconnected to a central system.

Recommendation

Allow City to operate ramp terminal traffic signals within WSDOT guidelines.

Advantages	Disadvantages
• Improves traffic operations on Local Street by providing cohesive signal coordination plans within one agency with no translation problems between signal controller types. • Does not impact WSDOT ability to manage traffic signals upstream of ramp meters because the ramp terminals impacted have no on-ramps.	• May affect mainline operation (I-5 & Ramps) if not properly coordinated with WSDOT Traffic Operations.

Summary of Cost Analysis

	Cost
Baseline	N/A
Recommendation	N/A
Difference	N/A

FHWA Functional Benefit

Safety	Operations	Environment	Construction	Other
	✓			

WSDOT Practical Design	**Lowers Cost**	**Will lower life cycle costs for WSDOT**
	Easy to Implement	**Moderate**

Recommendation No. 3 Signal Operations	IDEA NO. CA-11 & CA 20

Comments/Justification

Improve signal coordination by having one agency control all signal timing consistent with the rest of the local agency. This will decrease delay and queue lengths. It should also minimize vehicle conflicts particularly rear end collisions.

Figure 17 – Signal Locations

Currently WSDOT controls all signals at ramp terminals. The controllers are different than what the City of Federal Way uses and the software is incompatible too. Although coordination is feasible it is essentially time-based coordination because the different systems are not synchronized consistently. WSDOT response to public concerns may vary in addition to translating timing data between controller software.

Recommendation No. 3 Signal Operations	IDEA NO. CA-11 & CA 20

Assumptions/Calculations

All existing traffic signals have interconnect and can be connected to City system. City would assume cost of replacing signal controllers for system continuity. This would apply to the ramp terminals on SR 161 to assure coordination with City-controlled signals to the north and the new signal at 16th Avenue S and S 356th Street to the west.

If VE Recommendation No. 4 is implemented, this recommendation would also apply to the reconstructed signal at SR 18 and I-5 southbound off-ramp to assure coordination along SR 18 / S 348th Street to the west.

All cost impacts to this VE Recommendation would be picked up by the City of Federal Way.

Performance Measures

Attributes and Rating Rationale for Recommendation	Performance	Baseline	Recommendation
Mainline Operations • Will improve the traffic movement on the ramp terminal.	Rating	5	6
	Weight	26.7	
	Contribution	133	160
Local Operations • Will improve the traffic movement on the local streets.	Rating	5	7
	Weight	30.0	
	Contribution	150	210
Maintainability • Same as Baseline	Rating	5	5
	Weight	16.7	
	Contribution	83	83
Construction Impacts • Same as Baseline	Rating	5	5
	Weight	6.7	
	Contribution	33	33
Environmental Impacts • Will maximize the green time for the impacted leg and minimize idling at the signal.	Rating	5	6
	Weight	20.0	
	Contribution	100	120
Total Performance:		**500**	**607**
Net Change in Performance:			**21%**

Recommendation No. 4 Southbound I-5 to Eastbound SR 18	IDEA NO. MA-17

Baseline

Construct an auxiliary lane for I-5 southbound traffic to access SR 18.

Southbound I-5 going to westbound SR 18 will take a ramp directly to SR 18. Traffic heading to eastbound SR 18 continues via a new structure over SR 18 and then takes a loop ramp to SR 18 eastbound.

Recommendation

Eliminate the new structure and the loop ramp to SR 18 eastbound.

Advantages	Disadvantages
• Reduces footprint • Significant cost reduction • Eliminates the need for a bridge over SR 18 • Provides a better transition between freeway and arterial street • Eliminates the merge point on eastbound SR 18 • Able to utilize the former westbound to southbound loop ramp which lowers construction impacts • Minimize geotechnical impacts and potential stability risks. • Able to utilize multiple turn lanes simultaneously. • Still allows for future expansion	• Delays to eastbound SR 18 that don't occur now • Eastbound SR 18 to northbound I-5 may be caught in the queue with eastbound SR 18 thru traffic

Summary of Cost Analysis

	Cost	Schedule
Baseline	$3.74 M	
Recommendation	$0.36 M	
Difference	$3.38 M x 100% markup = $6.76 M	

FHWA Functional Benefit

Safety	Operations	Environment	Construction	Other
✓	✓	✓	✓	✓

WSDOT Practical Design		
	Lowers Cost	Yes
	Easy to Implement	Moderate

Recommendation No. 4 Southbound I-5 to Eastbound SR 18	IDEA NO. MA-17

Comments/Justification

This option is part of an overall strategy to reduce project costs significantly enough to make funding the project viable in the near future in order to realize operational benefits immediately while preserving the full build-out option (baseline) at a future date if deemed necessary. The primary cost savings of this recommendation is the elimination of the proposed new structure over SR 18 to access the loop ramp and the elimination of the loop ramp itself.

The green in Figure 18 represents the existing ramp configuration.

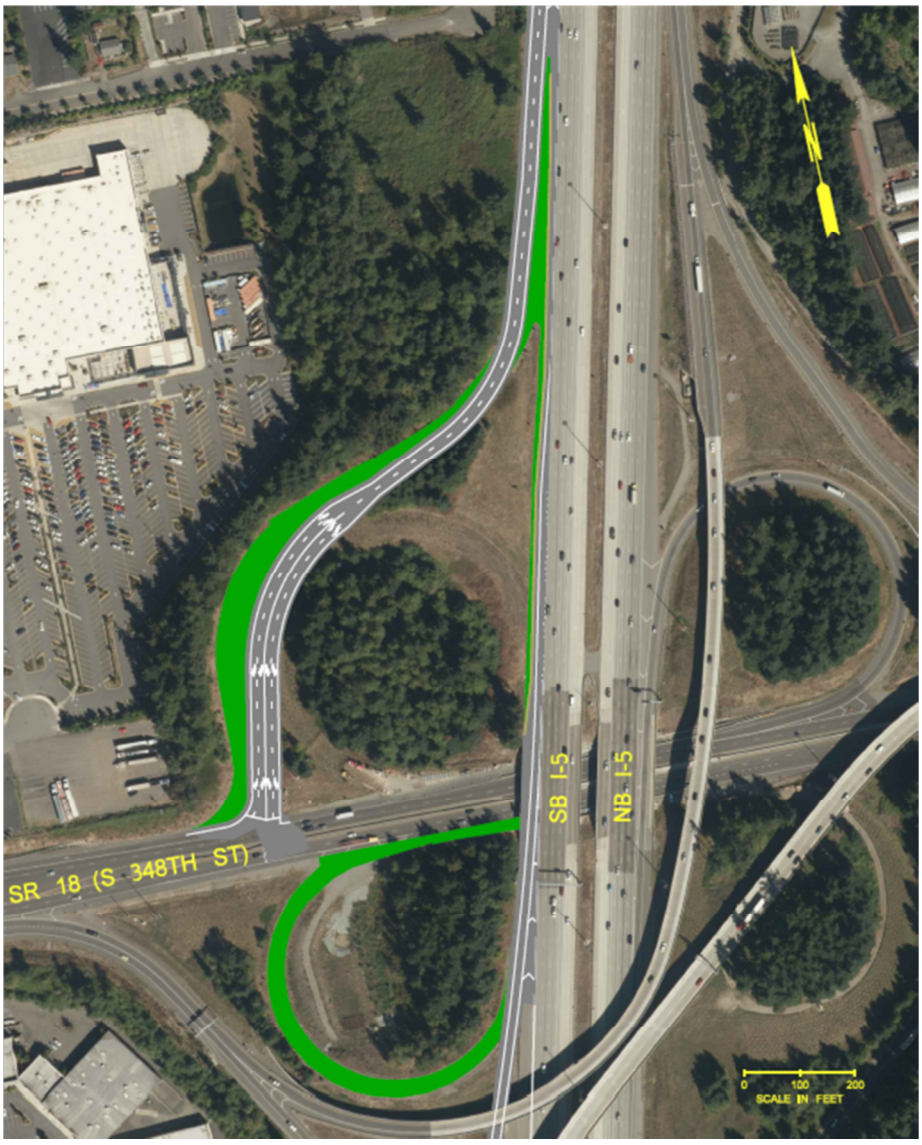

Figure 18 – I-5/SR 18 Interchange

Southbound I-5 traffic heading to either eastbound or westbound SR 18 will take a single ramp that roughly follows the existing southbound I-5 to westbound SR 18 off-ramp as shown in Figure 18. The ramp terminal will be a signal controlled intersection with westbound traffic turning right onto SR 18 and eastbound traffic turning left onto SR 18.

Recommendation No. 4 Southbound I-5 to Eastbound SR 18	IDEA NO. MA-17

Since the new structure over SR 18 is eliminated with this recommendation, conflicts between construction activities and existing traffic are significantly reduced. This will result in a significant reduction in required traffic control (may potentially reduce overall project traffic control costs by 50%). This recommendation virtually eliminates all potential conflicts between construction activities and existing I-5 southbound traffic. All required construction access for this recommendation can be done from SR 18 at the loop ramp that was previously abandoned during Stage 1.

Also, because the structure work is being eliminated and this recommendation requires only grading, paving, and signals, the newly proposed ramp can be constructed and operational in the first construction season.

Construction of the most recent widening of the I-5 structure over SR 18 experienced some issues related to geotechnical stability and excess water. By eliminating the new structure, any potential for these geotechnical/water problems is also eliminated.

Much of the grade of the new ramp either follows the existing westbound SR 18 off-ramp or follows the grade of the previously abandoned loop ramp for SR 18 eastbound to I-5 southbound that was replaced by a flyover ramp in Stage 1 of this interchange reconstruction project. Because the proposed ramp follows previous or existing roadbeds and does not require access to undisturbed areas, the impact to environmentally sensitive areas is reduced and the likelihood of subgrade problems during grade construction is significantly reduced.

An additional benefit of locating the ramp terminal at this location is the significant amount of width fronting SR 18 allows multiple turn lanes in both directions in order to move I-5 southbound to SR 18 eastbound/westbound traffic simultaneously in both directions. This will minimize the number of signal phases required and will reduce the amount of green time required to clear the ramp queues.

One of the additional benefits of this recommendation is the transition of SR 18 from arterial-to-freeway is relocated from its current location at South 348th Street to the newly proposed ramp terminal. By relocating the arterial-to-freeway transition to the end of the freeway ramp terminal, this is more consistent with current statewide conditions.

Also, since the loop ramp for SR 18 eastbound is being eliminated, the merging condition for SR 18 eastbound ramp traffic with eastbound SR 18 through traffic is also being eliminated.

Although the structure and loop ramp are being eliminated as part of this recommendation, the proposed condition allows for construction of the original baseline condition with a minimal amount of throw away construction.

Finally, although this recommendation is believed to be operationally viable, if for some reason the single ramp condition will not function to an acceptable level of service, the project team should strongly consider widening the existing I-5 structure over SR 18 in lieu of constructing a completely new structure.

Recommendation No. 4 Southbound I-5 to Eastbound SR 18	IDEA NO. MA-17

Assumptions/Calculations

A combined ramp can handle traffic volumes:

PM Peak traffic volumes controlled:

1,330 VPH southbound I-5 to westbound SR 18

1,150 VPH southbound I-5 to eastbound SR 18

Eastbound SR 18 to northbound I-5 fly-over appears to be controlling AM Peak, which should reduce conflicts with the PM Peak for the ramp traffic.

Recommended Savings

- Savings From Elimination of Structure: $2.89 Million
- Reduction of Overall Project Traffic Control: Reduction of approx. 50% of total project traffic control = 50% x $1.08 Million = $0.54 M
- Reduction in required asphalt paving: (1,000' ramp x 32' width x 1' depth)/27 x 2.05 tons/CY = 2,430 tons of HMA @ $76/ton = $184,680 savings
- Reduction in required guardrail (includes end treatments): 1,000 LF x $40/foot = $40,000 savings
- Reduction in required gravel borrow: (1,000' long x 40' wide x 5' depth)/27 = 7,407 CY @ $12/cy = $88,884 savings

Summary of savings: $2.89 M (structure) + $0.54 M (traffic control) + $0.18 M (HMA) + $0.04 M (guardrail) + $0.09 M (gravel borrow) = $3.74 Million

Additional cost for the proposed combined ramp:

- Additional traffic signal: $250,000
- Additional gravel borrow for wider ramp: (1,000' long x 14' wide x 5' deep)/27 = 2,593 CY @ $12/cy = $31,116
- Additional HMA for wider ramp: (1,000' long x 14' wide x 1' deep)/27 x 2.05 tons/CY = 1,063 tons HMA @ $76/ton = additional $80,788

Total additional cost related to recommendation = $0.25 M (signal) + $0.03 M (earthwork) + $0.08 M = $0.36 M

Total proposed savings = $3.74 Million (savings) less $0.36 Million (added cost) equals a total proposed savings of $3.38 Million.

In addition assumption used in this calculation is that all necessary striping, signing, drainage, roadside restoration, clearing and grubbing and electrical requirements for the additional ramp are offset by the same requirements for the deleted loop ramp. As a result, no calculations were performed for these items.

Recommendation No. 4 Southbound I-5 to Eastbound SR 18			IDEA NO. MA-17
Performance Measures			
Attributes and Rating Rationale for Recommendation	**Performance**	**Baseline**	**Recommendation**
Mainline Operations • Would not impact mainline I-5 operations.	Rating	5	5
	Weight	26.7	
	Contribution	133	133
Local Operations • Eliminate ramp merge to eastbound SR 18. • Adds queue delay to eastbound SR 18. • May add queue delay for eastbound SR 18 to northbound I-5.	Rating	5	5
	Weight	30.0	
	Contribution	150	150
Maintainability • Eliminates structure, guardrail/barrier maintenance.	Rating	5	8
	Weight	16.7	
	Contribution	83	133
Construction Impacts • Eliminate SR 18 impacts for new structure. • Better utilizes existing alignments for staging.	Rating	5	8
	Weight	6.7	
	Contribution	33	53
Environmental Impacts • Small reduction in sensitive area impacts.	Rating	5	6
	Weight	20.0	
	Contribution	100	120
Total Performance:		**500**	**590**
Net Change in Performance:			**18%**

Recommendation No. 5 Roundabout at 356th Intersection	IDEA NO. C-16

Baseline

Realign 16th Avenue to the west and create a new signalized intersection across from the approach into Lowe's. Reconfigure the signalized intersection at SR 161/356th with the new ramp terminal.

Recommendation

Construct a roundabout to replace the two existing signalized intersections.

Advantages	Disadvantages
• Left turns and U-turns are easier to perform • Peak and off-ramp operations are improved • Pedestrians will be served more quickly, less pedestrian delay • Lower speeds, less conflicts • Gateway treatment for the City • Mostly Maintenance Free • Ramp cross section would be reduced by at least 12 ft. or one lane width	• Higher volume roundabout with multiple lanes which may require rectangular rapid flashing beacons for crossings • Constructing this under traffic will be more complex than base unless seasoned roundabout construction staging people are involved • Will require a more substantial input process • Less expensive than the "base" based on right-of-way needed for base condition

Summary of Cost Analysis

	Construction Cost	Right-of-Way Cost
Baseline	$1.87 M	$5.04 M
Recommendation	$2.50 M	$1.97 M
Difference	($0.63 M) x 100% markup = ($1.26 M)	$3.07 M

FHWA Functional Benefit

Safety	Operations	Environment	Construction	Other
✓	✓	✓		

WSDOT Practical Design	**Lowers Cost**	**Yes**
	Easy to Implement	**Yes**

Recommendation No. 5 Roundabout at 356th Intersection	IDEA NO. C-16

Comments/Justification

The signalized intersections of S. 356th Street with SR 161 and 16th Avenue S. in Federal Way are approximately 50 feet apart and are currently operating near capacity. The close spacing of the intersections can result in large vehicles being caught between the signals with portions of the vehicle extending into the intersections. 16th Avenue S. is the primary access route for Todd Beamer High School (TBHS).

The City of Federal Way plans to improve S. 356th Street as an alternate east-west route to reduce congestion on S. 348th Street.

Baseline - Stage 2 of the I-5/SR 18/SR 161 Interchange Improvements (I-5 Triangle) project will construct a new off-ramp from southbound I-5 to SR 161 terminating at S. 356th Street. The additional traffic volume from the planned off-ramp from southbound I-5 to the SR 161 and S. 356th St intersection would further degrade operation of the existing intersection.

As shown in the figure below, the baseline would shift the signalized intersection of S. 356th Street and 16th Avenue S. approximately 300 feet west of the current location to align with an existing commercial access on the north side of S. 356th Street. The existing slip lane from southbound SR 161 to 16th Avenue S. would be closed and a right turn lane added for southbound SR 161 at the intersection of SR 161 and S. 356th Street. This option would provide a left turn lane with approximately 300 feet of storage on S. 356th Street to 16th Avenue S.

Figure 19 – Baseline 16th Avenue Realignment (Option A)

Recommendation No. 5 Roundabout at 356th Intersection	IDEA NO. C-16

The VE/PD Recommendation is to construct a roundabout to replace the two existing intersections.

As shown in the figure below, the roundabout would need three lanes northbound and two lanes southbound due to heavy traffic volumes on SR 161. Also because of the volumes, traffic may need to be metered in order to avoid blocking out the other legs during periods of high volumes.

Assuming the roundabout was designed to match the grade of SR 161, the legs connecting to S. 356th Street and 16th Avenue S. would have lengthy grade transitions from the roundabout back to existing ground in order to meet WSDOT design guidelines. Based on preliminary investigation, S. 356th Street would need a 450 foot transition at a 4% maximum grade and 16th Avenue S. would need an 890 foot transition at a 7% maximum grade. On S. 356th Street, this would have minor impacts on three commercial driveways. On 16th Avenue S., this would require closing one commercial driveway; land-locking that property and reconstruction with grades of up to 11% of two driveways, one each for two multi-unit residential properties.

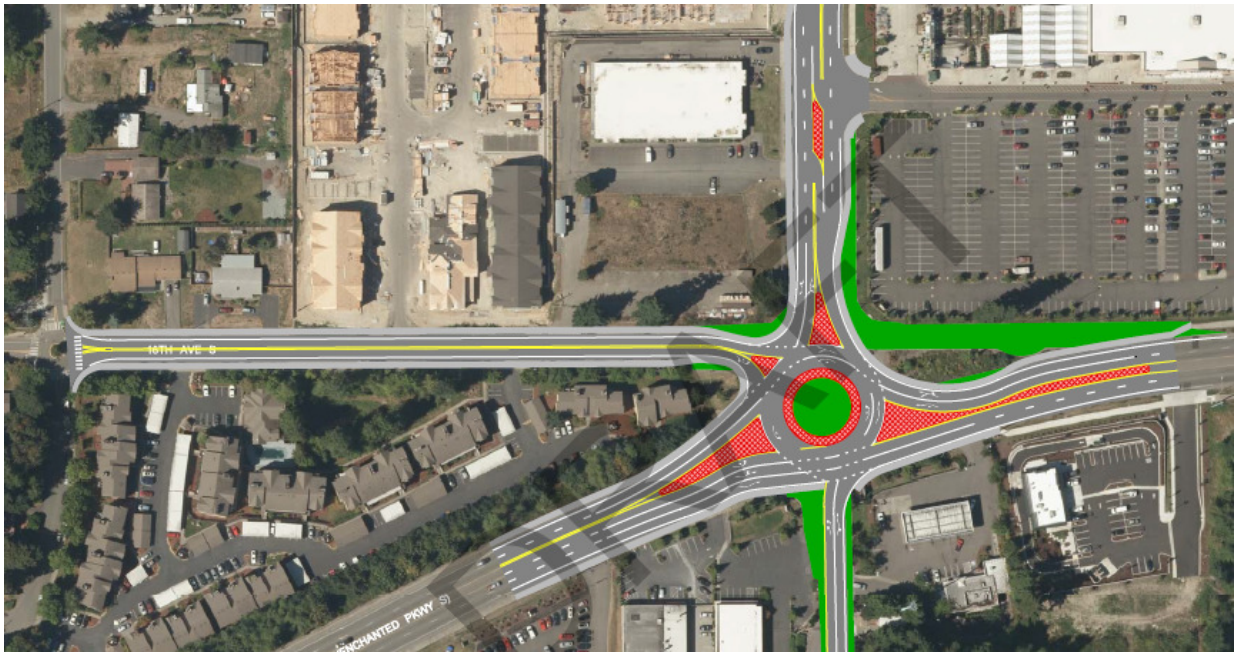

Figure 20 – VE/PD Roundabout (Option C)

Recommendation No. 5 Roundabout at 356th Intersection	**IDEA NO.** C-16

Assumptions/Calculations

The base cost on this project includes an added cost for a large change to 16th Avenue grade, (approximately $2.50 million). As a City of Federal Way street, the City is willing to accept a steeper grade to minimize disruption to adjacent properties and reduce project scope.

One of the assumptions with the roundabout at this location would be to find ways to make the roundabout less circular and potentially shift it further north to minimize the grade rework issue included in the base condition. Buying property was assumed in the base condition and VEPD Recommendation No. 7 would move towards either minimizing or eliminating property and access purchases. The baseline assumed $5.04 M for additional right-of-way acquisitions. This VE/PD recommendation will require only $1.97 M in right of way and access purchases.

Another assumption is that a revised capacity analysis may show that a two-lane roundabout would be adequate, which is more consistent with driver expectancy in the vicinity. Nonetheless, a two-lane roundabout could be expanded to three lanes without additional right-of-way at the time that future traffic conditions would justify it.

For those reasons, $2.50 million for a multi-lane roundabout is assumed for construction and design costs and the efficiencies for including roundabout design in a larger design effort.

No additional intersection improvements would be needed with the one roundabout and this concept works with independently and with other recommendations.

Recommendation No. 5 Roundabout at 356th Intersection			**IDEA NO.** C-16
Performance Measures			
Attributes and Rating Rationale for Recommendation	**Performance**	**Baseline**	**Recommendation**
Mainline Operations • Less queuing on off-ramp to S 356th Street, reducing rear-end collision frequency.	Rating	5	6
	Weight	26.7	
	Contribution	133	160
Local Operations • Less intersection delays than two signals that need to be coordinated with rest of City network. • Less roadway conflicts • Improved pedestrian mobility	Rating	5	8
	Weight	30.0	
	Contribution	150	240
Maintainability • Lower operation and maintenance costs	Rating	5	8
	Weight	16.7	
	Contribution	83	133
Construction Impacts • Construction sequencing and maintenance of traffic is more complicated	Rating	5	4
	Weight	6.7	
	Contribution	33	27
Environmental Impacts • Reduced greenhouse gas emissions	Rating	5	7
	Weight	20.0	
	Contribution	100	140
Total Performance:		**500**	**700**
Net Change in Performance:			**40%**

Recommendation No. 6 Access to Paint Store/ Auto Shop	IDEA NO. CA-23

Baseline

Full limited access within 300 ft. of the ramp terminal with SR 161.

Recommendation

Full limited access within 130 ft. of the new ramp terminal and modified access for remaining 170 ft. to reduce impacts to commercial property.

Advantages	Disadvantages
• Eliminate business relocation. • Meets current guidelines.	• None.

Summary of Cost Analysis

	Construction Cost	Right-of-Way Cost
Baseline	N/A	$4.80 M
Recommendation	N/A	$0.72 M
Difference	N/A	$4.08 M

FHWA Functional Benefit

Safety	Operations	Environment	Construction	Other
		✓		

WSDOT Practical Design	**Lowers Cost**	**Yes**
	Easy to Implement	**Moderate**

Recommendation No. 6 Access to Paint Store/ Auto Shop	IDEA NO. CA-23

Comments/Justification

This option reduces commercial impacts to the community at no cost to WSDOT and should reduce right of way costs.

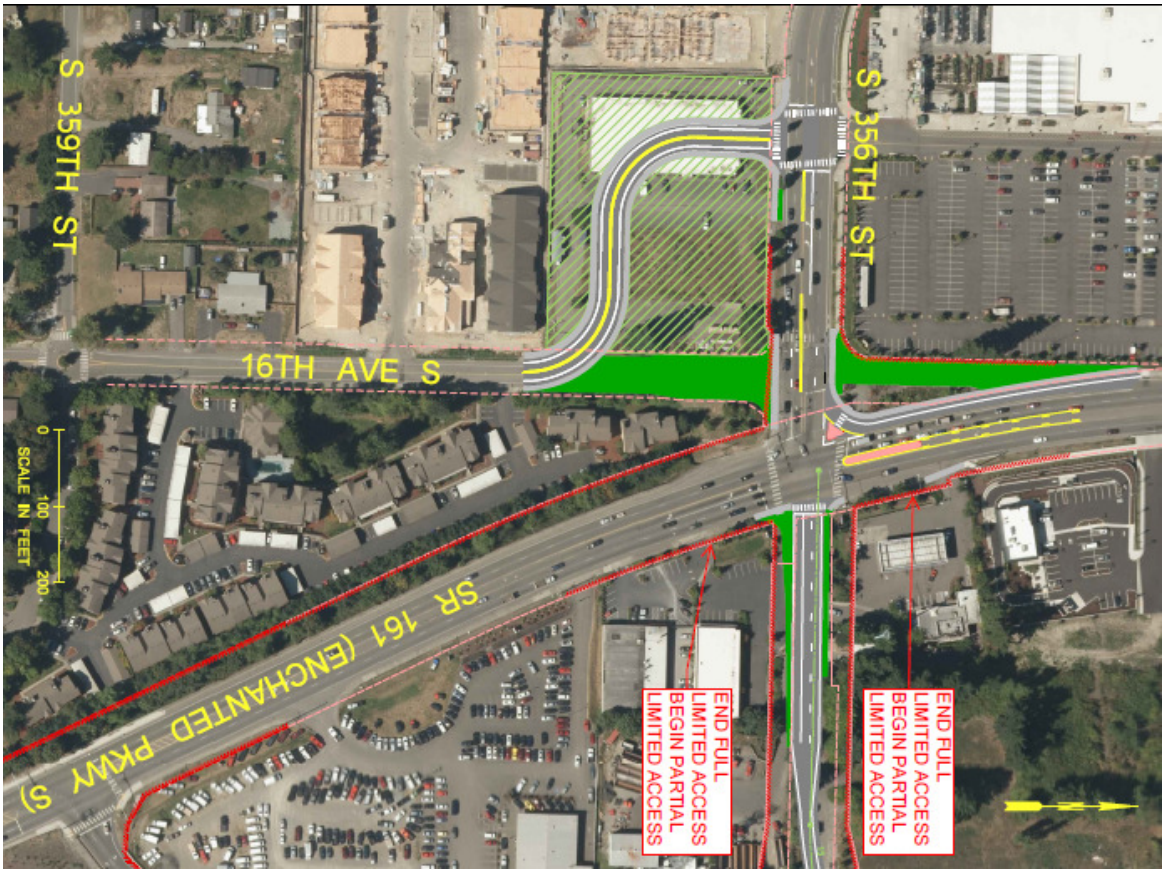

Figure 21 – VE/PD Access Control

If VE/PD Recommendation 7 is accepted this recommendation would not be needed.

Assumptions/Calculations

Purchasing modified limited access is less expensive than total acquisition of property.

Modified limited access will allow current business access on SR 161 to remain in place.

The total right-of-way acquisition cost from the provided estimate for 4 properties is $9.60 million. With no breakdown provided to determine the cost of each individual property it is assumed that the Paint Store and the Auto Shop are $4.80 million of this estimate.

Assume that if access is purchased it would be approximately 15% of the total cost or $0.72 million for a $4.08 million savings.

Recommendation No. 6 Access to Paint Store/ Auto Shop			IDEA NO. CA-23
Performance Measures			
Attributes and Rating Rationale for Recommendation	**Performance**	**Baseline**	**Recommendation**
Mainline Operations • No change to baseline	Rating	5	5
	Weight	26.7	
	Contribution	133	133
Local Operations • More access points along SR 161	Rating	5	4
	Weight	30.0	
	Contribution	150	120
Maintainability • No change to baseline	Rating	5	5
	Weight	16.7	
	Contribution	83	83
Construction Impacts • No change to baseline	Rating	5	5
	Weight	6.7	
	Contribution	33	33
Environmental Impacts • Reduces impacts to businesses	Rating	5	7
	Weight	20.0	
	Contribution	100	140
Total Performance:		**500**	**510**
Net Change in Performance:			**2%**

Recommendation No. 7 New Ramp Terminal	IDEA NO. C-32

Baseline

The southbound off-ramp from I-5 to SR 161 is currently a one lane ramp that widens to 3 lanes at the intersection of SR 161 and 356th Street. The addition of this ramp requires the acquisition of 4 commercial properties in order to provide the necessary limited access.

Recommendation

Move the end of the access controlled area approximately 500' to the east. Establish a ramp terminal using a roundabout and connect to SR 161 using a City street.

Advantages	Disadvantages
• Moves the limited access away from SR 161 • It would allow the City street to remain allowing the businesses to continue to access SR 161 • Roundabout ramp terminal would provide a gateway and prevent wrong way movements and a well defined transition from interstate and City street speeds • Continues to provide access to WSDOT surplus property which improves the value	• Profile may require roundabout to be slightly smaller and non circular to minimize cut and fill • Added cost since it is a new intersection

Summary of Cost Analysis

	Construction Cost	Right-of-Way Cost
Baseline	$0	$9.60 M
Recommendation	$0.80 M	$1.44 M
Difference	($0.80 M) x 100% markup = ($1.60 M)	$8.16 M

FHWA Functional Benefit

Safety	Operations	Environment	Construction	Other
✓	✓	✓		

WSDOT Practical Design		
	Lowers Cost	Yes
	Easy to Implement	Moderate

Recommendation No. 7 New Ramp Terminal	IDEA NO. C-32

Comments/Justification

If this is a Design Build project, efficiencies will be realized in a bigger design effort that involves I-5 ramps, etc.

Based on a ramp terminal roundabout example in Thurston County on size and placement and serving as a transition roundabout from a higher speed to lower speed facility, an ICD would be in the 100 to 125' range and serve the design vehicle and business property to the north.

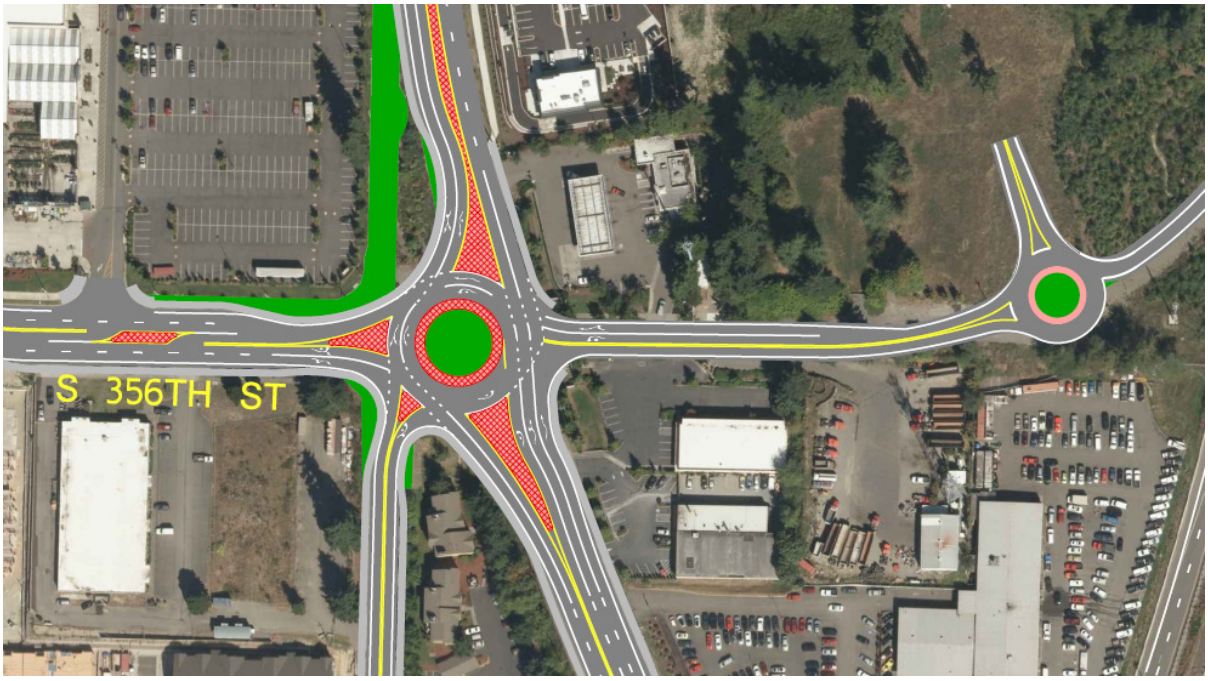

Figure 22 – VE/PD Relocated Ramp Terminal

Shifting the ramp terminal will allow the limited access to terminate east of SR 161, and may eliminate a large portion of the property acquisition along SR 161.

The roundabout for the ramp terminal can be constructed on the existing WSDOT right-of-way acquired during Stage 1 of this project.

Assumptions/Calculations

Based upon previously constructed one lane roundabouts with no right-of-way acquisition, the estimated construction cost of this roundabout is $0.80 million.

The costs for the reconstructed portion of 356th between SR 161 and the new ramp terminal are already included in the provided estimate.

The right-of-way needed at the intersection of the baseline ramp terminal is $9.60 million. The VE/PD recommended ramp terminal would not require and right-of-way only the purchase of some access control. Assume 15% of the cost of the baseline right-of-way need or $1.44 million.

Recommendation No. 7 New Ramp Terminal			IDEA NO. C-32
Performance Measures			
Attributes and Rating Rationale for Recommendation	**Performance**	**Baseline**	**Recommendation**
Mainline Operations • This recommendation will slow the ramp traffic prior to the intersection of SR 161 and 356th Street allowing it to function better	Rating	5	6
	Weight	26.7	
	Contribution	133	160
Local Operations • Moving the ramp terminal to the east will allow the local street grid to continue to operate by providing access to local businesses	Rating	5	8
	Weight	30.0	
	Contribution	150	240
Maintainability • WSDOT will not be responsible for maintenance and operation of the intersection	Rating	5	7
	Weight	16.7	
	Contribution	83	117
Construction Impacts • No change to baseline	Rating	5	5
	Weight	6.7	
	Contribution	33	33
Environmental Impacts • Reduces right-of-way acquisitions and impacts to businesses	Rating	5	8
	Weight	20.0	
	Contribution	100	160
Total Performance:		**500**	**710**
Net Change in Performance:			**42%**

Appendix

- VE Recommendation Approval Form
- VE/PD Workshop Agenda
- VE/PD Workshop Attendee List
- VE/PD Workshop Report Out Presentation
- VE Study Process

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VE Study Recommendation Approval Form

Project: I-5/SR 161/SR 18 Interchange Improvements – Stage 2 **VE Study Date:** December 2-4 & 8, 2014

	Recommendation	Approved Y/N	FHWA Functional Benefit: Safety	Operations	Environment	Construction	Other	VE Team Estimated Cost Avoidance or Cost Added	Actual Estimated Cost Avoidance or Cost Added
1	Reduce Widths							$3.10	
2	Nested Guardrail							$0.06	
3	Signal Operations								
4	Southbound I-5 to Eastbound SR 18							$6.76	
5	Roundabout @ 356th							$1.81	
6	Access Control							$4.08	
7	Ramp Terminal							$6.56	
	Totals							$15.81 - $18.29	

Please provide justification if the value engineering workshop recommendations are **not** approved or are implemented in a modified form.

The Project Manager will review and evaluate the VE Team's recommendation(s) that are included in the Final Report. The Project Manager shall complete the VE Recommendation Approval form that is included in this report.

For each recommendation that is not approved or is modified by the Project Manager, justification needs to be provided. This justification shall include a summary statement containing the Project Manager's decision not to use the recommendation in the project.

The completed VE Recommendation Approval form including justification for any recommendations not approved or modified shall be sent to the State Value Engineering Coordinator/Manager by October 1 of each year so the results can be included in the annual Value Engineering Report to FHWA.

_____ _____

Signature Project Manager Date

_____

Name (please print)

FHWA Functional Benefit Criteria

Each year, State DOT's are required to report on VE recommendations to FHWA. In addition to cost implications, FHWA requires the DOT's to evaluate each approved recommendation in terms of the project feature or features that recommendation benefits. If a specific recommendation can be shown to provide benefit to more than one feature described below, count the recommendation in ***each category that is applicable.***

Safety:	Recommendations that mitigate or reduce hazards on the facility.
Operations:	Recommendations that improve real-time service and/or local, corridor, or regional levels of service of the facility.
Environment:	Recommendations that successfully avoid or mitigate impacts to natural and or cultural resources.
Construction:	Recommendations that improve work zone conditions, or expedite the project delivery.
Other:	Recommendations not readily categorized by the above performance indicators.

VE/PD Workshop Agenda

Washington State Department of Transportation

I-5/SR 161/SR 18 Interchange Improvements – Stage 2

December 2-4 & 8, 2014

Scope of the Value Engineering/Practical Design Workshop:

The scope of this Value Engineering/Practical Design Workshop is to identify, develop and present recommendations for the Washington State Department of Transportation (WSDOT) to consider for adding project value. The workshop will follow the approved SAVE-International 6-step Job Plan that includes the 1) Information, 2) Function Analysis, 3) Creative, 4) Evaluation, 5) Development and 6) Presentation phases.

Considerations & Comments:

- As part of the preparation for the workshop, each team member should review the project information package. Be prepared to ask relevant questions during the design presentation.
- Note that all times and activities are approximate and subject to updates as the workshop progresses. The Agenda is based on standard work hours of 8:00 AM to 5:00 PM and can be adjusted as necessary.
- We all have responsibilities back at the office, however our primary responsibility and commitment during the scheduled duration is to the VE/PD workshop and the process. It is important that each team member actively participate in all the team activities and phases. Please be aware of this and keep any breaks or outside contacts to a minimum. If absolutely required, as a team, we can schedule breaks for our other obligations. During the workshop itself, please refrain from checking emails if you have wireless connectivity.
- If anyone has any questions regarding the upcoming workshop or the information contained herein, please contact me at 360-705-4411, office; 360-742-7682, cell or Blane.Long@hdrinc.com. Also, do not hesitate to ask questions or clarifications regarding the VE/PD process at any time during the workshop. I look forward to working with you towards a successful workshop.

Logistics:

Location: WSDOT Northwest Region HQ, 15700 Dayton Ave. N, Seattle, WA 98133 Conference Room 4B

VE/PD Workshop Agenda

Tuesday, December 2	
Information Phase	
8:30 am	Welcome and Introductions
8:40 am	John White – Practical Design
8:50 am	Brief overview of Value Engineering & Practical Design
9:00 am	Project Team Presentation • Virtual Site visit (using Google Earth) • What are the Constraints and Controlling Decisions? • What are the Operational Considerations? • What are the major risks of the project?
10:00 am	VE Team review available project information
Noon	Lunch
Functional Analysis Phase	
1:00 pm	Define project functions & Performance Measures
Creativity Phase	
2:00 pm	Speculation (brainstorm ideas to improve the projects)
5:00 pm	Adjourn for the day
Wednesday, December 3	
Evaluation Phase	
8:00 am	Evaluate the ideas
Noon	Lunch
Development Phase	
1:00 pm	Develop best ideas into recommendations
5:00 pm	Adjourn for the day
Thursday, December 4	
8:00 am	Complete development of recommendations
10:00 am	Review Recommendations
Noon	Lunch
1:00 pm	Score Performance Attributes for Recommendations
2:00 pm	Adjourn for the week
Monday, December 8	
Presentation Phase	
Noon	Prep for presentation
1:00 pm	Present VE Findings
2:30 pm	Adjourn

VE/PD Workshop Attendees

I-5/SR 161/SR 18 Interchange Improvements – Stage 2

2014 September/October				NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE	
							Office	Cell
2	3	4	8				E-MAIL	
✓	✓	✓	✓	Blane Long	HDR	VE/PD Team Leader	(360) 570-4411	(360) 742-7682
							Blane.Long@hdrinc.com	
✓				Abdul Abdi	WSDOT NWR	Assistant PE	(206) 440-4271	
							ABDIA@wsdot.wa.gov	
✓	✓	✓		Aleta Borschowa	WSDOT NWR	Construction	(206) 768-5862	
							BORSCHA@wsdot.wa.gov	
✓	✓			Brian Walsh	WSDOT HQ	Traffic/Roundabouts	(360) 705-7986	
							WALSHB@wsdot.wa.gov	
Phone			Phone	Greg Lippincott	WSDOT HQ	Asst. State Design Engineer	(360) 705 7462	
							LIPPING@wsdot.wa.gov	
✓			✓	Hung Huynh	WSDOT NWR	Project Engineer	(206) 440-4311	
							HUYNHH@wsdot.wa.gov	
✓	✓	✓	✓	Jim Larson	WSDOT NWR	Design	(206) 440-4321	
							LARSOJR@wsdot.wa.gov	
✓				John White	WSDOT NWR	Asst. Regional Administrator	(206) 440-4695	
							WHITEJH@wsdot.wa.gov	
✓			✓	Cathy George	WSDOT NWR	Engineering Manager - Design	(206) 440-4774	
							GEORGCA@wsdot.wa.gov	

VE/PD Workshop Attendees

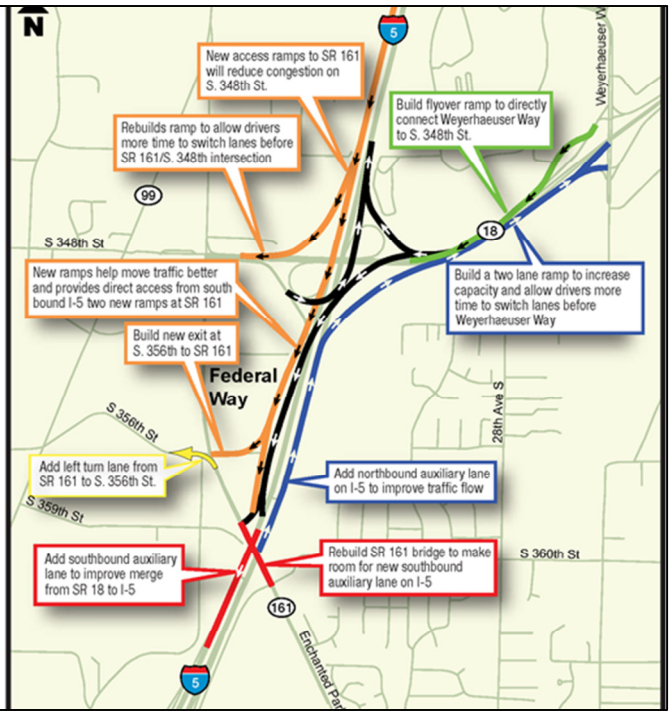
I-5/SR 161/SR 18 Interchange Improvements – Stage 2

2014 September/October				NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE	
							Office	Cell
2	3	4	8				E-MAIL	
✓	✓	✓	✓	Mazen Wallaia	WSDOT NWR	Design	(425) 456-8626	
							WALLAMA@wsdot.wa.gov	
✓				Messay Shiferaw	WSDOT NWR	Engineering Manager - Construction	(206) 440-4689	
							SHIFEME@wsdot.wa.gov	
✓	✓	✓	✓	Rick Perez	City of Federal Way	Traffic Engineer	(253) 835-2740	
							rick.perez@cityoffederalway.com	
	✓	✓	✓	Rob Brown	WSDOT NWR	Traffic	(206) 805-5416	
							BROWNR@wsdot.wa.gov	
✓	✓	✓		Roy Siegel	FHWA	Design	(360) 753-9552	
							roy.siegel@dot.gov	
✓	✓	✓	Phone	Samih Shilbayeh	WSDOT HQ	VE/CRA Coordinator	(360) 705-7589	
							shlbyhs@wsdot.wa.gov	
✓	✓	✓	✓	Thomas La Bolle	WSDOT NWR	Design	(206) 440-4293	
							LABOLLT@wsdot.wa.gov	
Phone	Phone		Phone	John Klockenteger	WSDOT HQ	Design	(360) 705-7244	
							klockenj@wsdot.wa.gov	

Value Engineering/Practical Design Report Out

VALUE ENGINEERING/ PRACTICAL DESIGN WORKSHOP

- I-5/SR 161/SR 18 Interchange Improvements – Stage 2



VE/PD TEAM

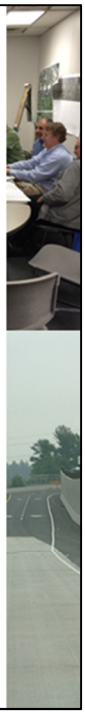
- Aleta Borshowa
- Blane Long (HDR)
- Rick Perez (City of Federal Way)
- Samih Shilbayeh
- Roy Siegel (FHWA)
- Mazen Wallaia
- Brian Walsh

Resources

- Thomas LaBolle
- Jim Larson

WHAT IS PRACTICAL DESIGN?

- It is an approach that….
  - focuses on the problem that needs to be addressed
  - engages local stakeholders early in the process to ensure their input is considered
  - empowers creative problem solving (remove obstacles)
- It is not…
  - a compromise of safety
  - "new tool" or "method"

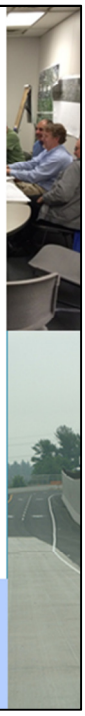


PRACTICAL DESIGN THROUGH VALUE ENGINEERING

- Practical design is achieved through Value Engineering via a systematic process used by a multidisciplinary team to improve the value of a project through the analysis of its functions.
- Value is defined as a fair return or equivalent in goods, services, or money for something exchanged.
- Solutions must not sacrifice performance, reliability, quality or safety.

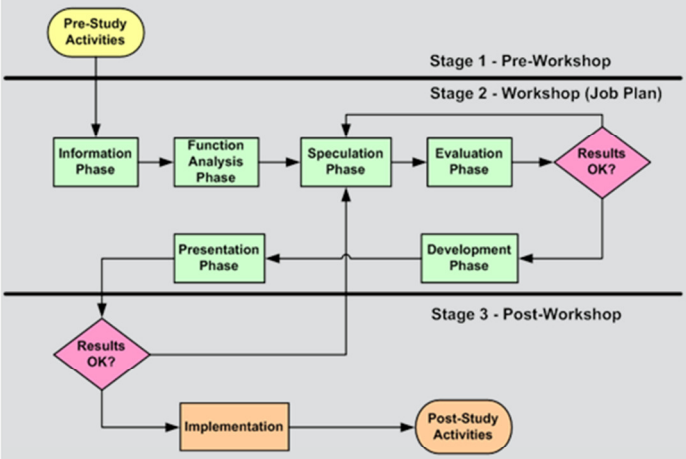
"**Price** is what you pay. **Value** is what you get."

~Warren Buffet



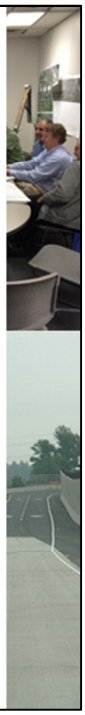
VE JOB PLAN

- Provides the structure for the VE/PD Workshop which is part of a 3-stage process
  1. Pre-Workshop
  2. Value Study
  3. Post-Workshop



PROJECT PURPOSE AND NEED STATEMENT

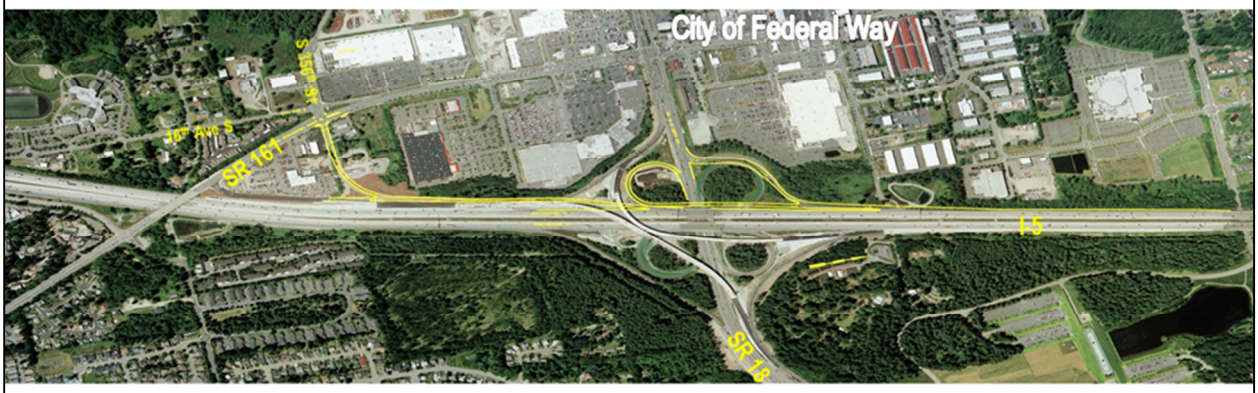
- The I-5 SR 161/SR 18 "triangle" interchange experiences severe traffic congestion. This project is the second stage of a multi-stage project to improve mobility and safety in the interchange vicinity.



I-5/SR 18/SR 161 Triangle Phase 2

Project Overview

Interchange Improvements



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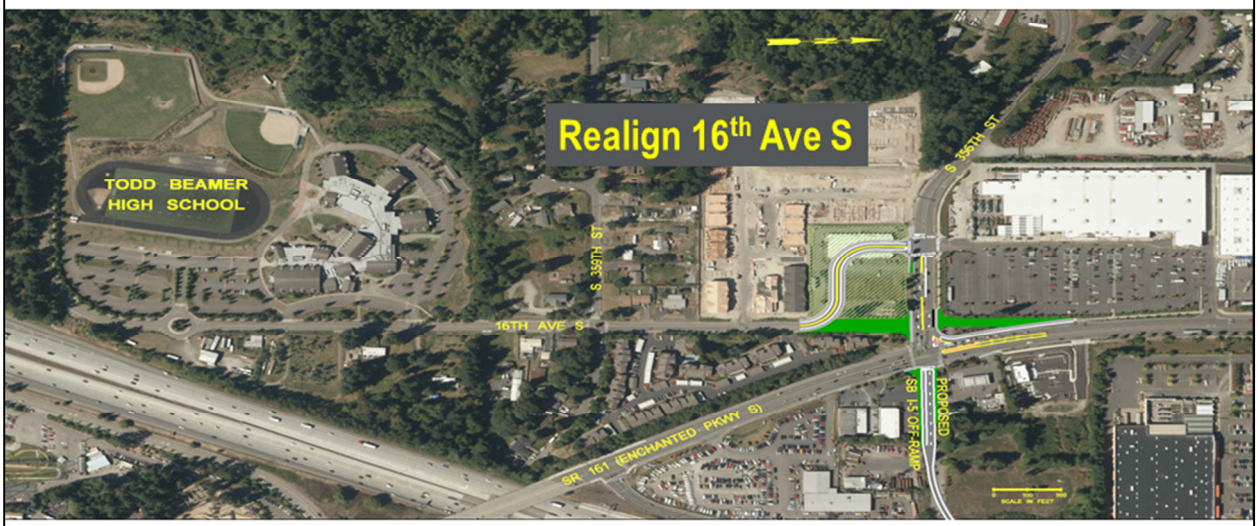
I-5/SR 18/SR 161 Triangle Phase 2

Project Overview

Interchange Improvements



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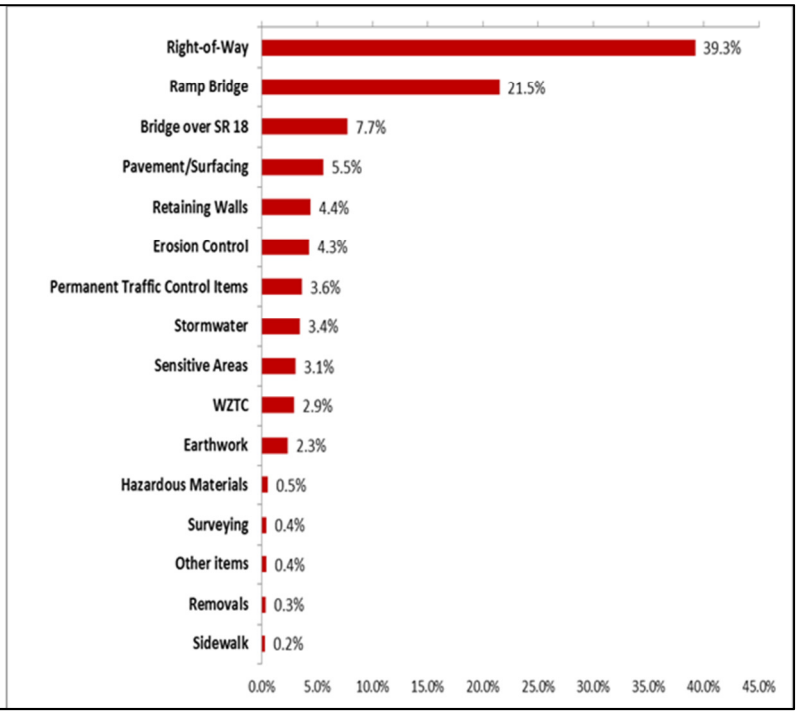
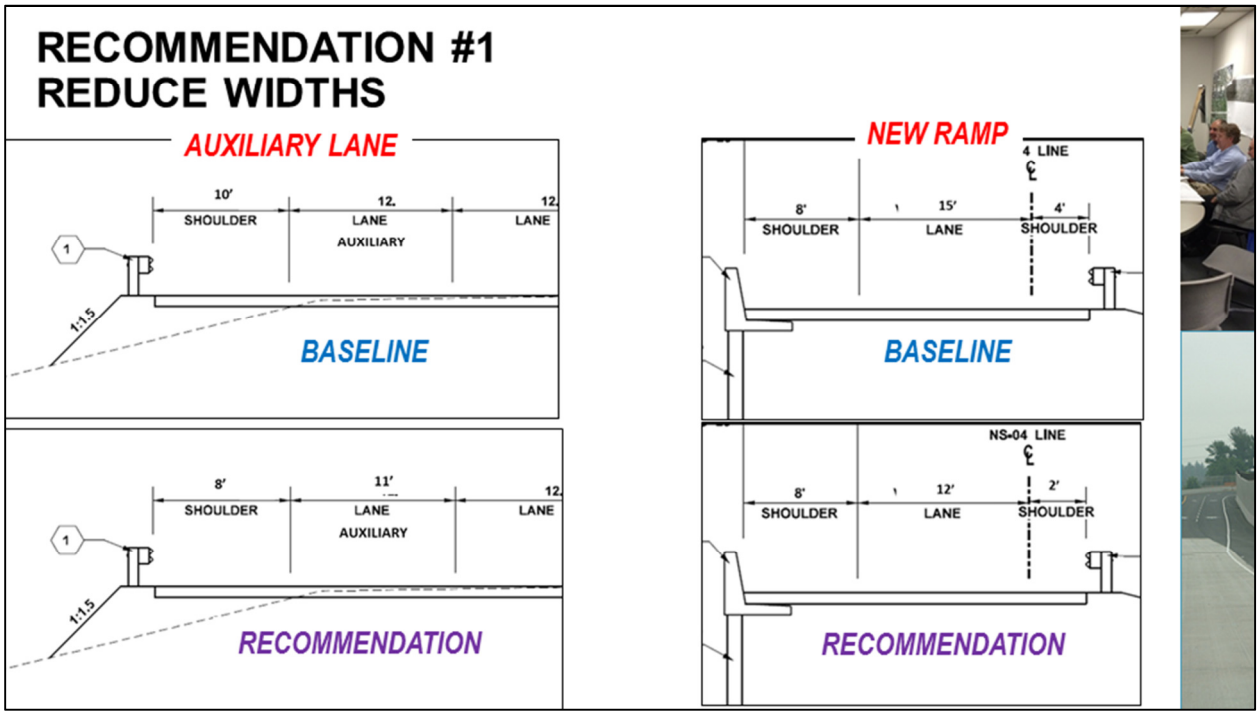
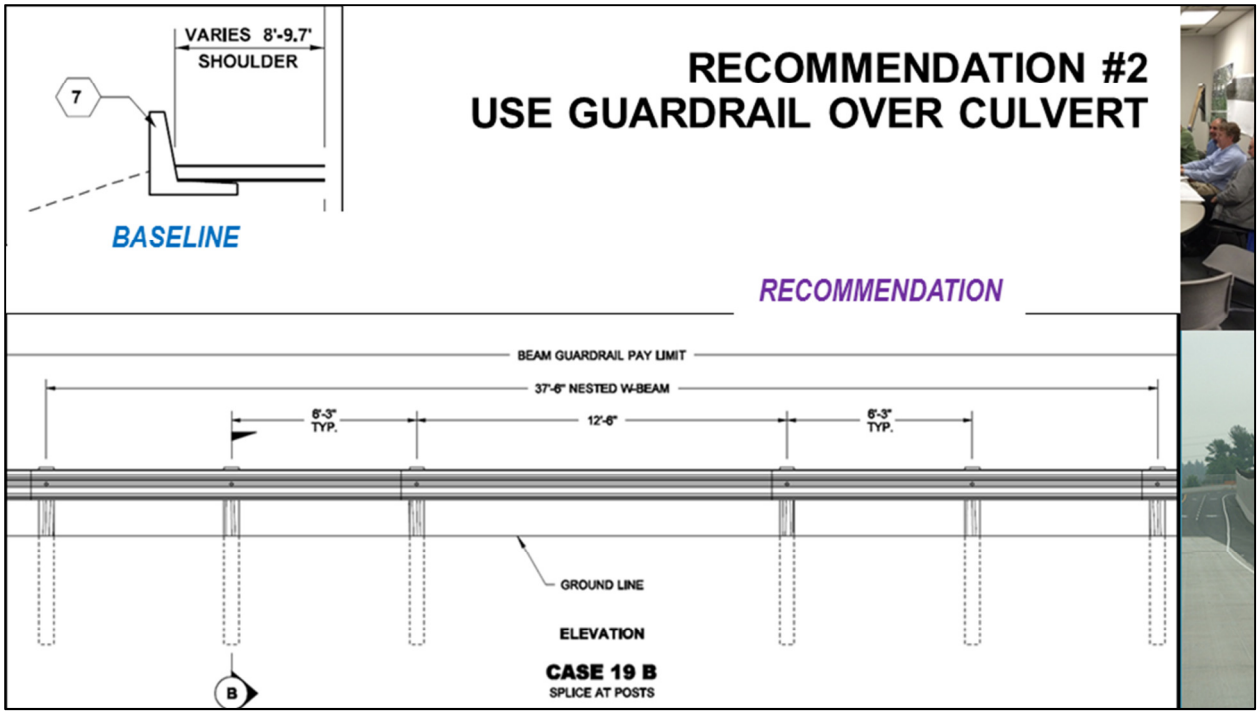
COST MODEL

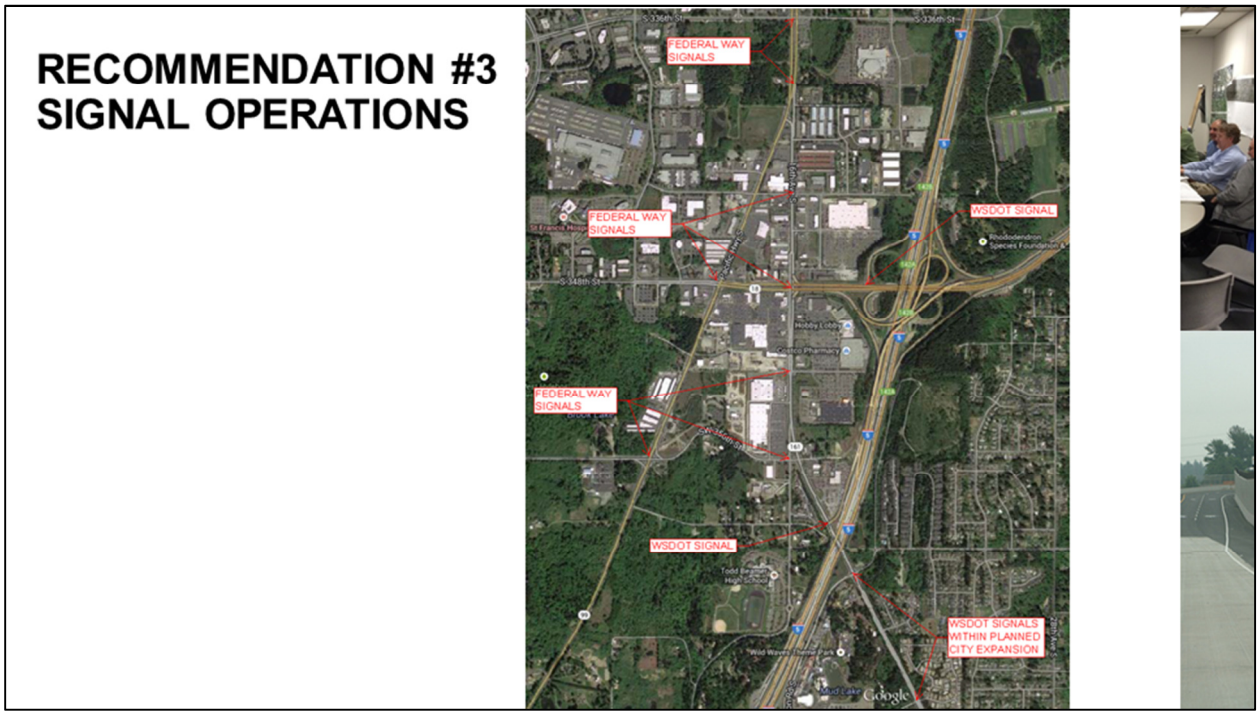
- 20% of the items contain 80% of the project costs

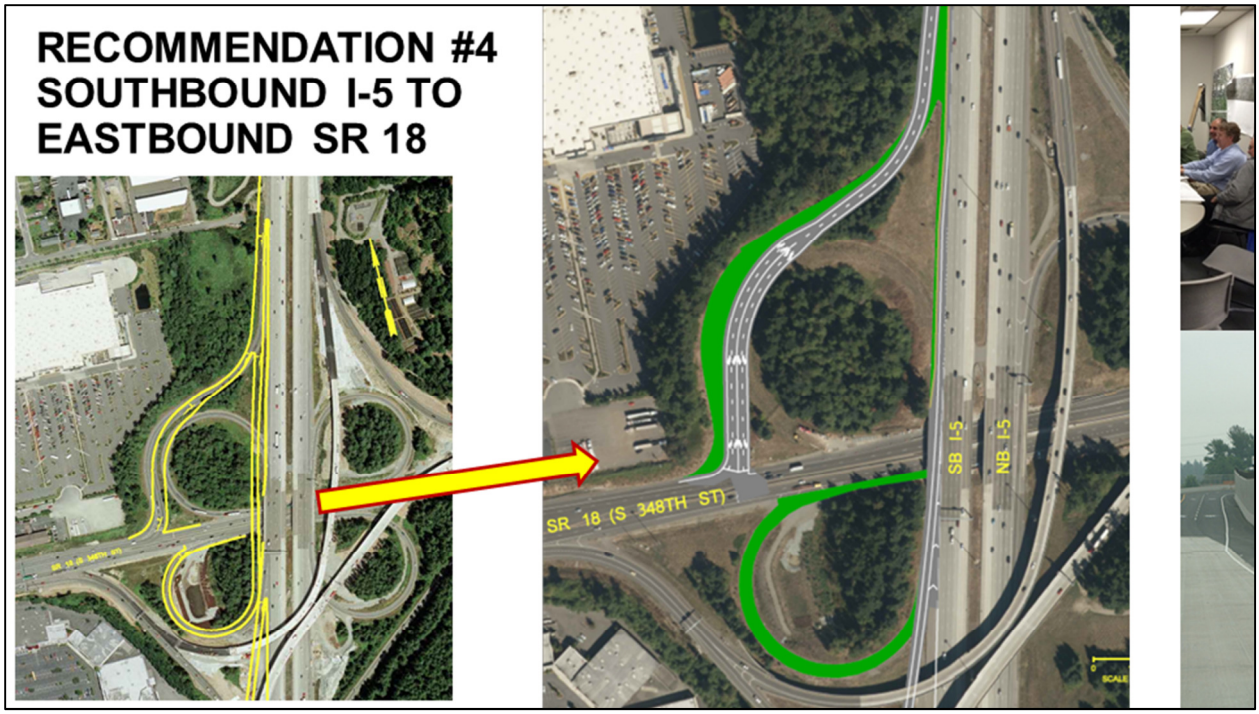


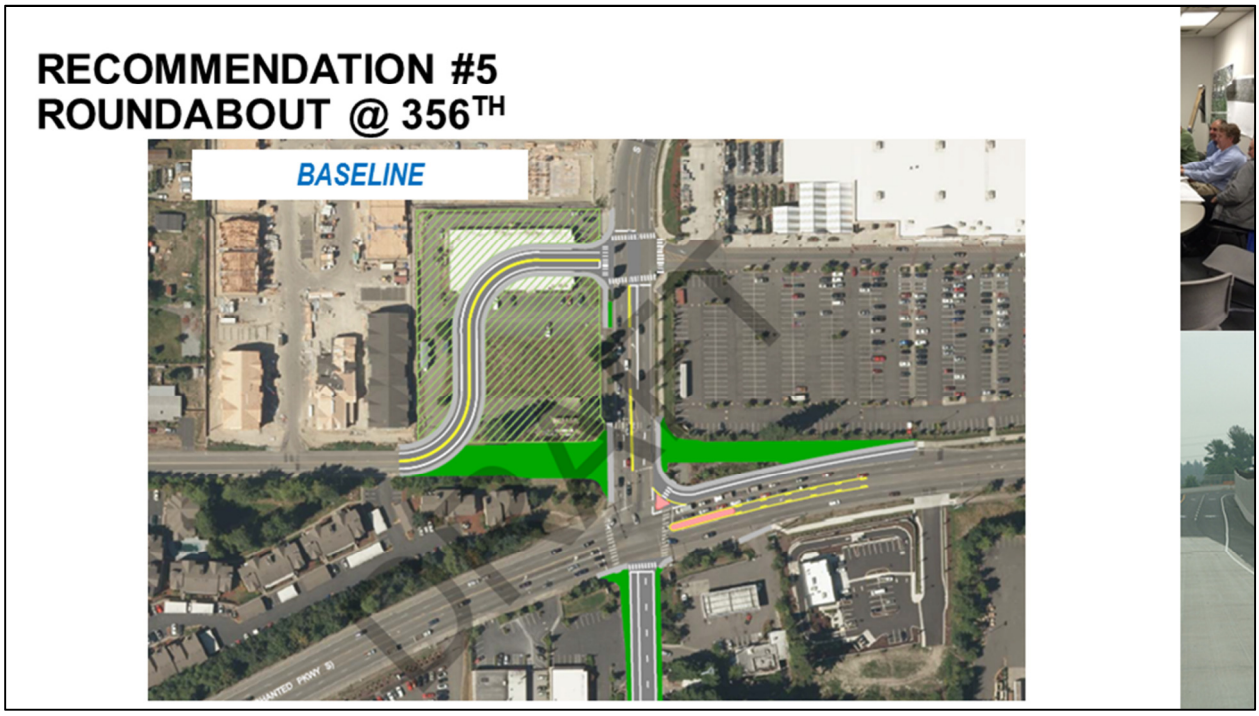
RECOMMENDATION #1
REDUCE WIDTHS



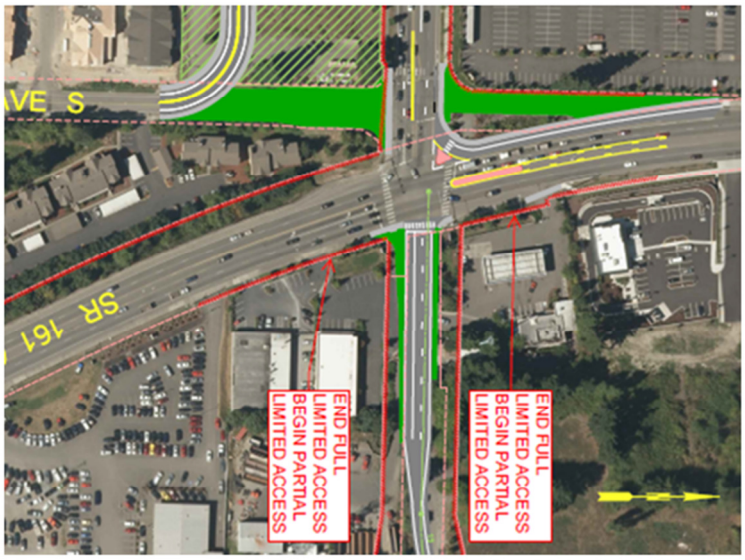

VARIES 8'-9.7'
SHOULDER
7
BASELINE
RECOMMENDATION #2
USE GUARDRAIL OVER CULVERT
RECOMMENDATION
BEAM GUARDRAIL PAY LIMIT
37'-6" NESTED W-BEAM
6'-3" TYP.
12'-6"
6'-3" TYP.
GROUND LINE
ELEVATION
CASE 19 B
SPLICE AT POSTS
B

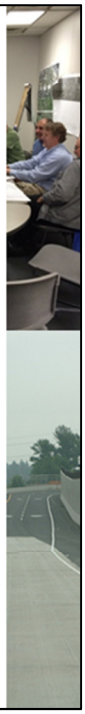

RECOMMENDATION #3
SIGNAL OPERATIONS
FEDERAL WAY SIGNALS
FEDERAL WAY SIGNALS
FEDERAL WAY SIGNALS
WSDOT SIGNAL
WSDOT SIGNAL
WSDOT SIGNALS WITHIN PLANNED CITY EXPANSION


RECOMMENDATION #4
SOUTHBOUND I-5 TO
EASTBOUND SR 18
SR 18 (S 348TH ST)
SB I-5
NB I-5

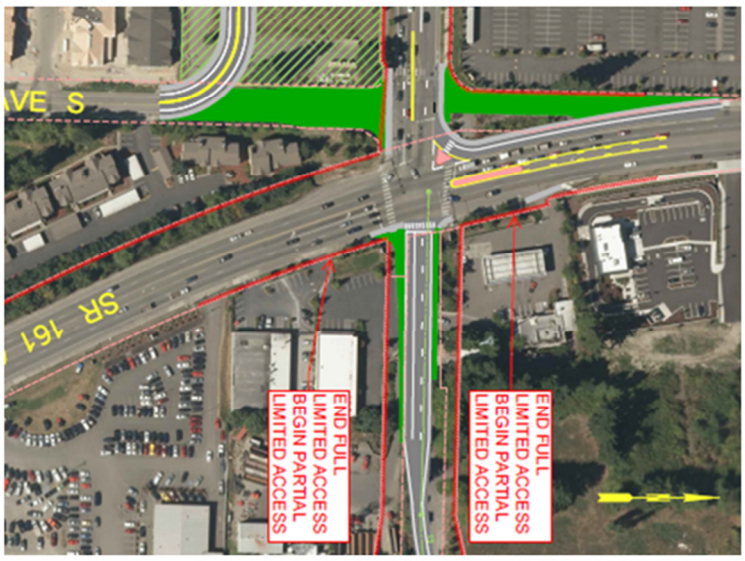

RECOMMENDATION #5
ROUNDABOUT @ 356TH
BASELINE

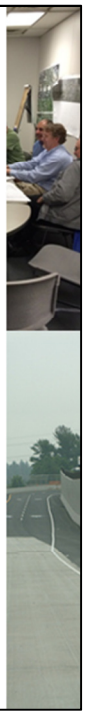
RECOMMENDATION #6
ACCESS CONTROL



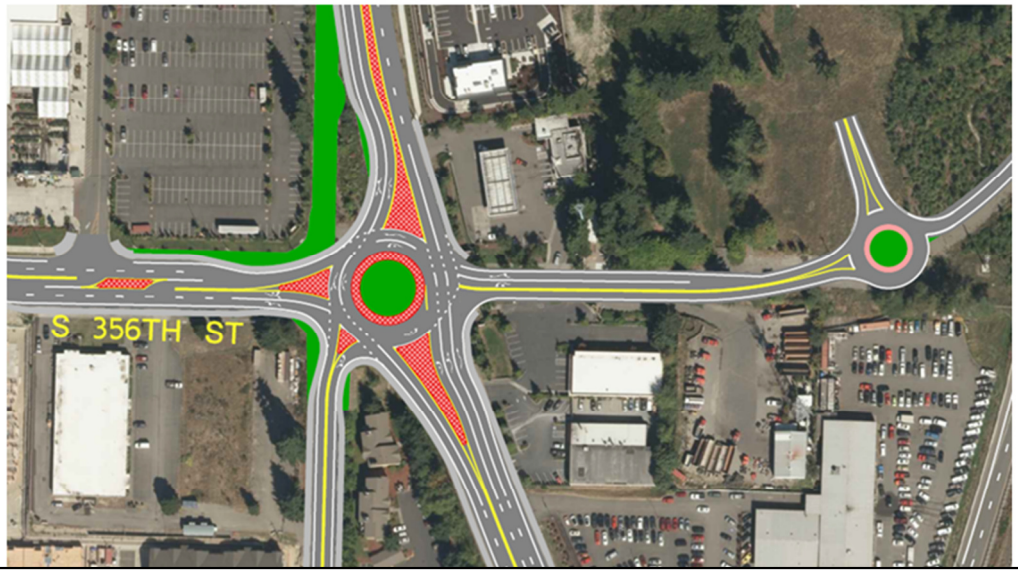


RECOMMENDATION #6
ACCESS CONTROL





RECOMMENDATION #7
MOVE RAMP TERMINAL



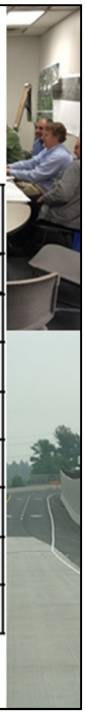
VE/PD SUMMARY

Table 6 - Summary of Recommendations (millions $)

#	Description	Construction Savings (Added)	Right-of-Way Savings	Performance
1	Reduce Widths	$3.10		7%
2	Nested Guardrail	$0.06		5%
3	Signal Operations			21%
4	Southbound I-5 to Eastbound SR 18	$6.76		18%
5	Roundabout @ 356th	($1.26)	$3.07	40%
6	Access Control		$4.08	2%
7	Ramp Terminal	($1.60)	$8.16	42%
	Total	**$8.66**	**$7.15 - $11.23**	

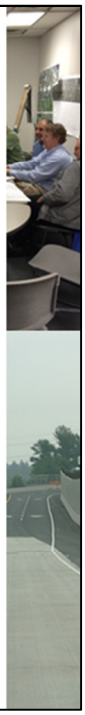
VE/PD SUMMARY

	OVERALL PERFORMANCE	Performance (P)	% Change Performance	Cost (C) $ millions	% Change Cost	Easy to Implement	% Value Index	% Value Improvement
	Baseline	500		$60.0		5	41.67	
1	Reduce Widths	537	7%	$53.8	10%	5	49.89	20%
2	Nested Guardrail	523	5%	$59.9	0%	7	61.19	47%
3	Signal Operations	607	21%	$60.0	0%	5	50.56	21%
4	Southbound I-5 to Eastbound SR 18	590	18%	$46.5	23%	4	50.79	22%
5	Roundabout @ 356th	700	40%	$56.4	6%	7	86.93	109%
6	Access Control	510	2%	$51.8	14%	7	68.88	65%
7	Ramp Terminal	710	42%	$46.9	22%	5	75.74	82%



NEXT STEPS

- Preliminary VE/PD Report will be sent out for comments on Monday December 22
- Please return comments by Monday January 5
- Final VE/PD Report will be submitted 5 working days after receiving all comments



Value Engineering Process

Value Engineering (VE) or Value Analysis (VA) is a systematic process using a multidisciplinary team to improve the value of a project through the analysis of its functions. The VE process incorporates, to the extent possible, the values of design; construction; maintenance; contractor; state, local and federal approval agencies; other stakeholders; and the public.

The primary objective of a VE Study is value improvement. The value improvements might relate to scope definition, functional design, constructability, coordination (both internal and external), or the schedule for project development. Other possible value improvements are reduced environmental impacts, reduced public inconvenience, or reduced project cost.

Pre-VE Study

Prior to the start of a VE Study, the Project Manager, VE Team Leader, and the State Value Engineering Coordinator/Manager typically carry out the following three activities:

- Initiate Study
- Prepare VE Study request
- Define scope, objective and goals of the study
- Define study timing

- Organize Study
- Conduct Pre-Study meeting
- Select team members
- Identify performance attributes (if applicable)

- Prepare Data
- Collect and distribute data
- Prepare cost models
- Prep for study.

All of the information gathered prior to the VE Study is given to the team members for their use.

Value Engineering Job Plan

The Value Engineering Job Plan was employed in analyzing the project. This process is recommended by SAVE International and is composed of the following phases:

Information - The objective of this phase was to obtain a thorough understanding of the project's design criteria and objectives by reviewing the project's documents and drawings, cost estimates, and schedules.

Functional Analysis - The purpose of this phase was to identify and define the primary and secondary functions of the project. A Functional Analysis System Technique (FAST) was used to quickly define the functions of the project.

Creative/Speculation - During this phase the team employed creative techniques such as team brainstorming to develop a number of alternative concepts that satisfy the project's primary functions.

Evaluation - The purpose of this phase was to evaluate the alternative concepts developed by the VE Team during the brainstorming sessions. The team used a number of tools to determine the qualitative and quantitative merits of each concept.

Development - Those concepts that ranked highest in the evaluation were further developed into VE recommendations. Narratives, drawings, calculations, and cost estimates were prepared for each recommendation.

Presentation - The VE Team presented their finding in the form of a written report. In addition, an oral presentation was made to the owner and the design team to discuss the VE recommendations.

Implementation/Resolution - Evaluate, resolve, document and implement all approved recommendations.

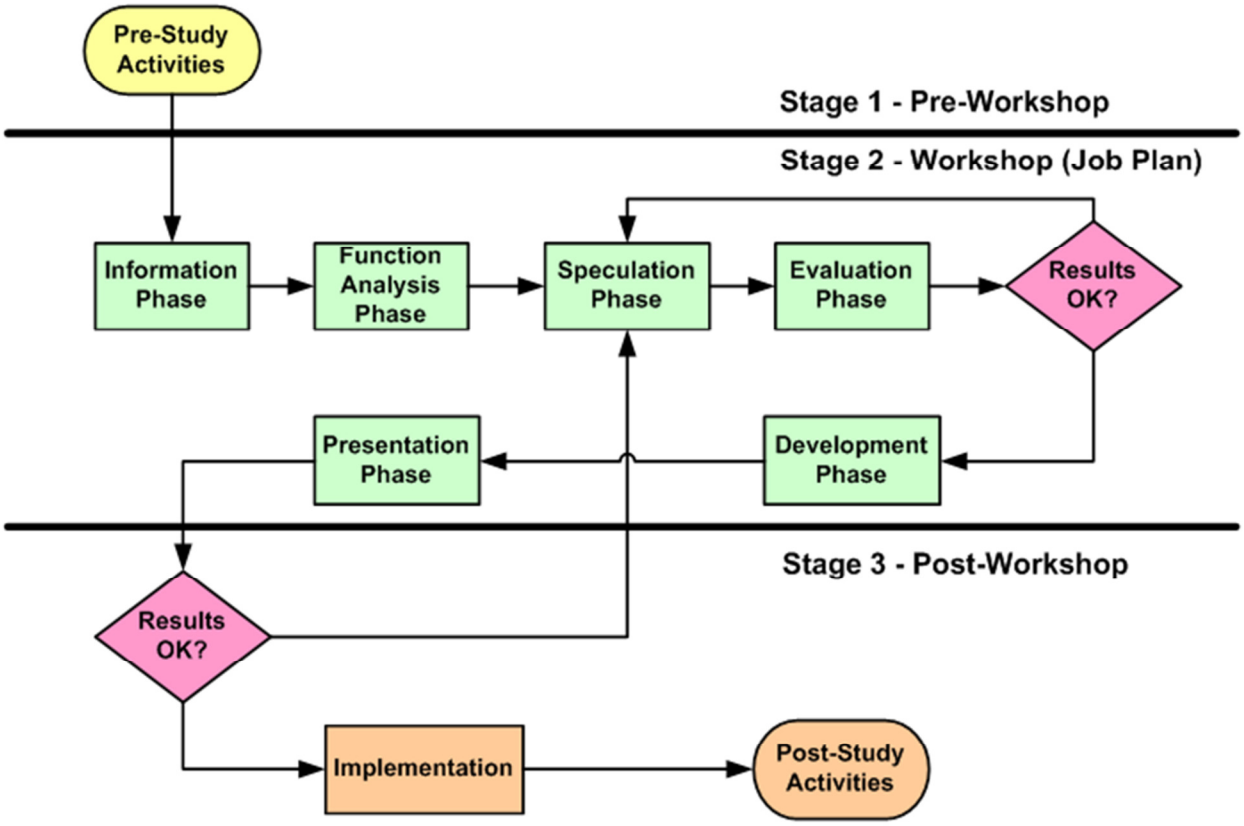


Figure 23 – Value Engineering Job Plan

Performance Based Results

Using performance attributes process is an integral part of the value engineering process. This process provides the cornerstone of the VE process by providing a systematic and structured means of considering the relationship of a project's performance and cost as they relate to value. Project performance must be properly defined and agreed upon by the stakeholders at

the beginning of the value study. The performance attributes and requirements developed are then used throughout the study to identify, evaluate, and document alternatives.

INTRODUCTION

The methodology described herein measures project value by correlating the performance of project scope and schedule to the project costs. The objective of this methodology is to prescribe a systematic, structured approach to study and optimize a project's scope, schedule, and cost.

Value engineering has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of overlooking the role that VE can play with regard to improving project performance. Project costs are fairly easy to quantify and compare through traditional estimating techniques. Performance is not so easily quantifiable.

The VE Team Leader will lead the team and external stakeholders through the methodology, using the power of the process to distill subjective thought into an objective language that everyone can relate to and understand. The dialog that develops forms the basis for the VE Teams' understanding of the performance requirements of the project, and to what degree the current design concept is meeting those requirements. From this baseline, the VE Team can focus on developing alternative concepts that will quantify both performance and cost and contribute to overall project value.

Performance based value engineering yields the following benefits:

- Builds consensus among project stakeholders (especially those holding conflicting views)
- Develops a better understanding of a project's goals and objectives
- Develops a baseline understanding of how the project is meeting performance goals and objectives
- Identifies areas where project performance can be improved through the VE process
- Develops a better understanding of a VE recommendation's effect on project performance
- Develops an understanding of the relationship between performance and cost in determining value
- Uses value as the true measurement for the basis of selecting the right project or design concept
- Provides decision makers with a means of comparing costs and performance (i.e., costs vs. benefits) in a way that can assist them in making better decisions

METHODOLOGY

The application of performance based value engineering consists of the following steps:

1. Identify key project (scope and delivery) performance attributes and requirements for the project
2. Establish the hierarchy and impact of these attributes upon the project

3. Establish the baseline of the current project performance by evaluating and rating the effectiveness of the current design concepts
4. Identify the change in performance of alternative project concepts generated by the study
5. Measure the aggregate effect of alternative concepts relative to the baseline project's performance as a measure of overall value improvement

The primary goal of value engineering is to improve project value. A simple way to think of value in terms of an equation is as follows:

$$Value = \frac{Performance}{Cost}$$

ASSUMPTIONS

Before embarking on the details of this methodology some assumptions need to be identified. The methodology described in the following steps assumes the project functions are well established. Project functions are "the what" the project delivers to its users and stakeholders; a good reference for the project functions can be found in the environmental document's purpose and need statement. Project functions are generally well defined prior to the start of the value study. In the event that project functions have been substantially modified, the methodology must begin a new from the beginning (Step 1).

STEP 1 – DETERMINE THE MAJOR PERFORMANCE ATTRIBUTES

Performance attributes can generally be divided between Project Scope components (Highway Operations, Environmental Impacts, and System Preservation) and Project Delivery components.

It is important to make a distinction between performance attributes and performance requirements. Performance requirements are mandatory. All performance requirements MUST be met by any idea being considered.

Performance attributes possess a range of acceptable levels of performance. For example, if the project was the design and construction of a new bridge, a performance requirement might be that the bridge must meet all current seismic design criteria. In contrast, a performance attribute might be Project Schedule which means that a wide range of alternatives could be acceptable that had different durations.

The VE Team Leader will initially request that representatives from project team and external stakeholders identify performance attributes that they feel are essential to meeting the overall need and purpose of the project. Usually four to seven attributes are selected. It is important that all potential attributes be thoroughly discussed.

The information that comes out of this discussion will be valuable to both the VE Team and the Project Owner. It is important that the attribute be discretely defined, and they must be quantifiable in some form. The vast majority of performance attributes that typically appear in

transportation value studies have been standardized. This standardized list can be used "as is" or adopted with minor adjustments as required. Every effort should be made to make the ratings as objective as possible.

STEP 2 – DETERMINE THE RELATIVE IMPORTANCE OF THE ATTRIBUTES

Once the group has agreed upon the project's performance attributes, the next step is to determine their relative importance in relation to each other. This is accomplished through the use of an evaluative tool termed in this report as the "Performance Attribute Matrix."

This matrix compares the performance attributes in pairs, asking the question: "An improvement in which attribute will provide the greatest benefit to the project relative to purpose and need?" A letter code (e.g., "a") is entered into the matrix for each pair, identifying which of the two is more important. If a pair of attributes is considered to be of essentially equal importance, both letters (e.g., "a/b") are entered into the appropriate box. This, however, should be discouraged, as it has been found that in practice a tie usually indicates that the pairs have not been adequately discussed.

When all pairs have been discussed, the number of "votes" for each is tallied and percentages (which will be used as weighted multipliers later in the process) are calculated. It is not uncommon for one attribute to not receive any "votes." If this occurs, the attribute is given a token "vote", as it made the list in the first place and should be given some degree of importance.

STEP 3 – ESTABLISH THE PERFORMANCE "BASELINE" FOR THE ORIGINAL DESIGN

The next step is to define the baseline as it pertains to each performance attribute. The baseline is then given a score of 5 on a scale of 0 to 10 for each attribute.

STEP 4 – EVALUATE THE PERFORMANCE OF THE VE RECOMMENDATIONS

Once the performance of the baseline has been established for the original design concept, it can be used to help the VE Team develop performance ratings for individual VE recommendations as they are developed during the course of the value study. The Performance Measures form at the back of each recommendation is used to capture this information.

It is important to consider the recommendation's impact on the entire project, rather than on discrete components.

STEP 5 – COMPARE THE PERFORMANCE RATINGS OF RECOMMENDATIONS TO THE "BASELINE" PROJECT

The last step in the process is to develop the performance ratings for the original design concept. The VE recommendations are rated and compared against the baseline concept. The performance ratings developed for the VE Recommendations are entered into the matrix, and the summary portion of is completed. The summary provides details on net changes to cost, performance, and value, using the following calculations.

- % Performance Improvement = Δ Performance VE Strategy / Total Performance Baseline Concept

- Value Index = Total Performance / Total Cost (in Millions)
- % Value Improvement = Δ Value Index VE Strategy / Value Index Baseline Concept

Reporting

Following the VE Study, the Team Leader assembles all study documentation into the draft/final reports:

- Publish Results – Prepare a draft and a final VE Study Report; distribute printed and electronic copies as needed.

The VE Study is complete when the report is issued as a record of the VE Team's analysis and development work, as well as the Project Team's implementation dispositions for the recommendations.